

Staff Present:

Leslie Baroody
Peter Ward
Tim Olson
Tobias Muench
Charles Smith
Pilar Magana

Also Present

Presenters

Gerhard Achteolik, California Air Resources Board (CARB)
John Mough, California Department of Food and Agriculture
Division of Measurement Standards (CDFA DMS)
Bill Elrick, California Fuel Cell Partnership

Panelists

Alex Keros, General Motors
Robert Bienenfeld, Honda
Justin Ward, Toyota
Todd Suckow, Hyundai/Kia
Rosario Barretta, Daimler
Dr. Arnold Miller, Vehicle Projects
Paul Scott, ISE
Lawrence Weisdorn, Vision Industries Corp.
John Maddox, BAE Systems
Tom Apalenek, BAE Systems
David Pfeil, Plug Power
Jaimie Levin, AC Transit
Dr. Tim Brown, UC Irvine
Rob Elam, Propel
Michael Beckman, Linde
Ed Heydom, Airproducts
Kevin Harris, Hydrogenics

Public

Robert Boyd, Linde North America
Michael Ramage, Asemblon (206) 200-7801
Larry Watkins*

(Via WebEx)

I N D E X

	Page
Introduction and Agenda Review	
Leslie Baroody, CEC	5
Peter Ward, CEC	8
Policy and Regulatory Presentations	
Gerhard Achtelik (California Air Resources Board)	16
- Zero Emission Vehicle Mandate	
- SB 1505 Requirements	
- Credits for Clean Fuel Outlets Trigger	
John Mough (California Department of Food and Agriculture Division of Measurement Standards (CDFA DMS))	37
- Standardization of Fuel	
Light Duty Vehicle Panel (co-moderated by Bill Elrick of the California Fuel Cell Partnership)	44
Panelists:	
- General Motors - Alex Keros	52
- Honda - Robert Bienenfeld	72
- Toyota - Justin Ward, Advanced Power train Program Manager	84
- Hyundai/Kia - Todd Suckow	105
- Daimler - Rosario Barretta	116
Heavy Duty Vehicle and Off-Road Applications Panel	
Panelists:	
- Vehicle Projects - Dr. Arnold Miller	127
- ISE - Paul Scott	140
- Vision Industries - Lawrence Weisdorn	147
- BAE Systems - John Maddox	156
- BAE Systems - Tom Apalenek	158
- Plug Power - David Pfeil	166
- AC Transit - Jaimie Levin	175

I N D E X (Continued)

Page

Fuel Production and Distribution Panel

Panelists:

- University of CA, Irvine - Dr. Tim Brown	185
- Propel - Rob Elam	200
- Linde - Michael Beckman	209
- Airproducts - Ed Heydom	221
- Hydrogenics - Kevin Harris	236

Public Comment

Robert Boyd, Linde North America	249
----------------------------------	-----

Michael Ramage, Asemblon	255
--------------------------	-----

Larry Watkins	262
---------------	-----

Closing Remarks	263
-----------------	-----

Adjournment	263
-------------	-----

Certificate of Reporter	264
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1 P R O C E E D I N G S

2 SEPTEMBER 29, 2009 9:03 a.m.

3 MS. BAROODY: I think we are going to actually
4 start on time today. Welcome to Sacramento and to the
5 California Energy Commission's fourth in a series of
6 workshops for the 2010-2011 Alternative and Renewable Fuel
7 and Vehicle Technology Investment Plan. We really
8 appreciate you taking the time to be here with us today.
9 And also, welcome, those of you who are listening online.
10 We have had some very successful and informative workshops
11 these past few weeks, and I expect today will be productive,
12 as well.

13 I would like to introduce our team from the
14 Emerging Fuels and Technologies Office of the Fuels and
15 Transportation Division. I am Leslie Baroody. I am Project
16 Manager for the 2010-2011 Investment Plan. With me is
17 Charles Smith, Assistant Project Manager. Peter Ward and
18 Tim Olsen, they authored last year's Investment Plan and are
19 experts on alternative transportation fuels and
20 technologies. Tobias Muench is our hydrogen specialist and
21 he will be helping to moderate the panels today with Peter
22 and Tim and Bill Elrick. Pilar Magana, who you have already
23 met, will be assisting us today with the WebEx and the
24 PowerPoint presentations. This meeting is being publicly
25 broadcast via WebEx and the transcript and audio will be

1 posted on our website.

2 Well, I have a few housekeeping items I need to go
3 over with you. For those of you not familiar with this
4 building, the closest restrooms are out this back door to
5 your left, there is a snack bar on the second floor under
6 the white awning, and lastly, in the event of an emergency
7 or a fire drill, the building will be evacuated, just follow
8 staff to the appropriate exits and we will reconvene at
9 Roosevelt Park which is located diagonally across the street
10 from this building. So that should do it for that.

11 Well, the main purpose of today's workshop is for
12 the Energy Commission staff to acquire information needed to
13 provide the basis for allocating \$100 million in AB 118
14 funds. We need updated information on vehicle deployment
15 and cost, fueling infrastructure, fuel production, and
16 barriers to commercialization. This workshop is a beginning
17 of a data collection process. We will continue with a
18 review of the docketed materials and subsequent dialogue.

19 Well, we certainly have a full agenda today and we
20 want to have time for public comments for those in the
21 audience and those on WebEx. Our introductory speakers will
22 be Peter Ward, who will provide an overview of the AB 118
23 Investment Plan process. Gerhard Achtelik of the California
24 Air Resources Board, he will speak on the zero emissions
25 vehicle mandate, SB 1505 requirements and credits for clean

1 outlets trigger; John Mough of the Department of Food and
2 Agriculture will speak on fuel standardization; the light
3 duty vehicle panel will be in the latter half of the
4 morning; and we will break for lunch at 11:45. At 1:00, we
5 will begin the heavy duty vehicle and off-road applications
6 panel, followed by the fuel production and distribution
7 panel at 2:30; at 4:00, we will have the public comment
8 session with closing remarks at 4:30. And if all goes
9 according to plan, we should be adjourning by about 4:45.

10 As I mentioned before, this is the fourth in a
11 series of workshops that we have had in September. We have
12 one more workshop scheduled for the electric drive
13 infrastructure on October 12th, and that will be held at the
14 CPUC in San Francisco. Just please check our website for
15 further details.

16 Well, the next step in this Investment Plan
17 process is for staff to analyze and incorporate all the
18 information that we have gathered at these workshops. We
19 plan to produce a draft of the Investment Plan in time for
20 our first Advisory Committee meeting on November 19th of
21 2009. We will then have two more public workshops for the
22 Draft Investment Plan, followed by another Advisory
23 Committee Meeting in January. We hope to have a final draft
24 some time in January of 2010. So if you are not already on
25 our list serve, I encourage you to sign up on our website

1 under AB 118, it is in the lower right-hand corner, it is
2 very simple, you just put your name and e-mail in there and
3 you will be on our list serve. So, thank you so much for
4 your attention and I will hand over the mic to Peter Ward.

5 MR. WARD: Good morning, everybody. Thank you all
6 for coming and thank you all for those that are listening in
7 on the WebEx; we really appreciate it. This is going to be
8 an interesting day today, it always is when we are talking
9 about our Investment Plan, and particularly in view of the
10 fact that we are talking about hydrogen technology and
11 commercialization today. We have a good showing here.

12 I would like to go over kind of where we have
13 been, how we got to this point, and where we are going to be
14 going in the future. And we have a very good give and take
15 today; I am looking forward to that myself.

16 California is a big state and it could be a nation
17 state, a population of nearly 37 million people, possibly
18 the eighth largest economy, and one of the largest
19 contributors to GHG emissions in the country. We have 26
20 million light duty and medium duty vehicles and nearly a
21 million trucks. The annual fuel consumption is about 20
22 billion gallons a year, and that is well over a billion and
23 a half gallons a month. In and of itself, we are one of the
24 largest consumers behind China and the U.S. as a whole, 16
25 billion gallons of gasoline, and 4 billion gallons of diesel

1 annually. That is a very big market, it seems appropriate
2 that a lot of the hydrogen development that is going on
3 occurs in this state, as we are going to be needing all the
4 alternative fuels to move forward and to reduce our
5 petroleum consumption over time, reduce our GHG emissions
6 over time, criteria emissions, as well, and improve our
7 economy, many of the public benefits we hope that this
8 program will provide.

9 The California Alternative Fuels Plan was adopted
10 in December of 2007, jointly adopted by the Air Resources
11 Board and the California Energy Commission. It was preceded
12 by a jointly crafted report from the Air Resources Board and
13 the Energy Commission, jointly adopted, as well, setting
14 goals for California to establish alternative fuels at 20
15 percent level by 2020, thereby being able to reduce our
16 petroleum consumption by 15 percent in that same time frame,
17 also to set a goal for 30 percent alternative fuels in 2030.
18 In the Alternative Fuels Plan, we have with us the principal
19 author of that, Tim Olsen is up on the dais there, he can
20 answer any questions specifically about that plan, as he was
21 intimately involved in that over many months in creation.
22 We set a little bit finer goals within that plan, getting to
23 the Alternative Fuels Use, and those goals were set at 9
24 percent in 2012, 11 percent in 2017, and 26 percent in 2022.
25 And we found in that report that these are goals that are

1 attainable under a moderate development scenario. One
2 major thing that the Alternative Fuels Plan was one of its
3 firsts was the Full Fuel Cycle Analysis of all the fuels
4 that were being looked at. This is pretty much
5 unprecedented at that time, and was very conveniently timed
6 for the initiation of the Low Carbon Fuel Standard. We had
7 already begun work of the Full Fuel Cycle Analysis with a
8 modified GREET model developed and cooperatively extended
9 with Michael Wang at Argon National Lab. That work
10 continues for our program, and it is a governing principal
11 for our program as we want to make sure that we have a
12 sustainable program going forward, and set sustainable goals
13 going forward for the development of these alternative
14 fuels. We feel that we can displace 4 billion gasoline
15 gallon equivalents by the year 2020; that would achieve the
16 20 percent goal, and, as I mentioned earlier, all the fuels
17 in the portfolio will be necessary to achieve that goal.
18 Hydrogen fuels and technologies can make an important
19 contribution to this goal with corresponding reductions in
20 GHG and air pollution, as well.

21 Now, to the Alternative Fuels Plan -- I mean,
22 actually, the program that will help implement that plan --
23 this is the Renewable Fuel and Vehicle Technology Program.
24 It was established by legislation, statutes of 2007, former
25 Speaker Fabian Nuñez, Assembly Bill 118, created the

1 program, and was subsequently amended by AB 109, also by
2 Speaker Nuñez. It is important to note that the emphasis of
3 this program is to develop and deploy innovative
4 technologies that transform California's fuels and vehicle
5 types to attain the state's climate change policies. And,
6 of course, we are talking about the Global Climate Solutions
7 Act, signed by the Legislature and signed by the Governor in
8 September of 2006, and the early actions and other policies
9 that stem from that AB 32 climate change program. We feel
10 that this program can be a leader in that sense, we think it
11 can lead not only other states, but our nation and other
12 nations, as we move forward to develop those fuels in the
13 most sustainable way possible, with the clear thought to
14 what implications we have for the development of these fuels
15 in California and how that basic amount of knowledge that we
16 will be gaining will be transferrable, as I say, to other
17 states, our nation, and other nations around the world.

18 The funding and objectives for the program, up to
19 \$200 million per year, was authorized for a period of 7.5
20 years, and this gives an ample long term approach to the
21 development of these alternative fuels, and never before
22 have we had such a robust funding picture over many years,
23 enabling us to send a very strong signal to the market in
24 California, and that signal has been heard outside of our
25 borders, as well. The funding is to develop, produce,

1 manufacture, deploy alternative and renewable fuels,
2 advanced vehicles, vehicle efficiency improvements for on
3 and non-road applications, and we will be emphasizing
4 workforce training and job creation. It will foster the
5 education, promotion and technology centers of excellence,
6 and we will be preparing environmental market and technology
7 assessments all the way along this program. That last
8 element, I think, is particularly important for us as we
9 want to establish a sustainability moniker for this program;
10 I think it is important that we stay up to date and we plan
11 to stay up to date with all the emerging information on
12 these topics, particularly those that affect the Low Carbon
13 Fuel Standard, the Renewable Fuel Standard across the United
14 States, and as we try to develop the resources that
15 California has to produce alternative fuels in the state,
16 mostly from the renewable sources, and emphasizing our
17 available waste stream whenever possible.

18 You may know that we adopted our first Investment
19 Plan on April 22nd, Earth Day, of this year, and now we are
20 about the business of preparing this second Investment Plan,
21 and this workshop is a portion of that. We have had
22 previous workshops and we will have one more workshop after
23 this, as Leslie mentioned. But it just seems like yesterday
24 that we adopted this plan. We basically turned on a dime
25 and, in a strategic move which we had high hopes for, many

1 of those hopes were not realized, but we thought it might
2 be best to see if we could leverage the amounts that we had
3 in our Investment Plan to encourage Federal dollars to come
4 to California, for all those projects that were going to be
5 proposed under the American Recovery and Reinvestment Act,
6 the Federal Stimulus. Many, but not all of those
7 solicitations have been completed, evaluated, and awards
8 announced, not all though, we are still awaiting results
9 from the Advanced Bio-Refinery and I believe ARPA-E
10 Programs. But for the most part, we -- how is the best way
11 to put this -- we were under-inspired by the selection, or
12 the known selection of California projects, which we had
13 many good projects in California. We led the weight of our
14 Investment Plan to that and a lot of the public and private
15 investment of California. We did not do as well as we had
16 hoped, transportation left for vacation, we got a few
17 projects, even Clean Cities, we got a few projects that we
18 will be taking advantage of some of our investment funds.
19 But the battery component, battery and vehicle component
20 manufacturing solicitation, with \$2 billion, notably, we had
21 zero success in that, no dollars placed in California. That
22 having been said, we would like to turn the page now and
23 provide a State solicitation that will have several
24 categories in it over the next weeks, not months, to make
25 sure that a lot of those folks that had excellent projects

1 from our standpoint, in California, we want to help get
2 those realized and put on the books as soon as possible. So
3 we are working quite diligently right now to prepare those
4 solicitations that will feature the criteria and the desired
5 outcomes that we are hoping for our program, many of which
6 are in statute, so that we can come up with some of the best
7 projects in California, that can be a model for the rest of
8 the United States, and possibly the world, as well. That
9 solicitation will be released, as I mentioned, in weeks, not
10 months, and we are hoping to finalize the awards right after
11 the first of the year, if at all possible.

12 Many of the policies that we are hoping to shape
13 our solicitations around and provide benefit for, as I
14 mentioned earlier, climate change reduction goals of AB 32,
15 California's Low Carbon Fuel Standard, which will take
16 effect in about a year and a half from now, and Gerhard from
17 the Air Resources Board will be telling us more about that
18 today. The Federal Renewable Fuels Standards 1 and 2 has a
19 decided effect on how we go forward here in California, as
20 well. I would like to add one to this, and it is the
21 Bioenergy Action Plan and Bioenergy Goals that our Governor
22 set in his Executive Order, and those are that we increase
23 the amount of bioenergy resources and fuels derived from
24 bioresources on a projected path of goals of use and
25 production of that use within California. Those are

1 ambitious goals. We are number 1 in Agriculture here in
2 California and forestry, so if any state can achieve those
3 goals, I believe it is California. As we do that, we are
4 keeping a keen eye to the emerging sustainability
5 discussions that are going on. We want to make sure that
6 what we develop here in California is done in the most
7 sustainable manner possible, and we hope that what we do
8 here in California can be a model for the rest of the world.

9 The Investment Plan for the first two years is
10 highlighted here. Some of these funds were utilized,
11 actually taken up by the Federal solicitations, we have
12 quite a few of these dollars remaining for the
13 solicitations, and I think an approximation of this is about
14 \$100 million remaining, or more, probably exceeding that.
15 Some of the allocations that are not obvious here, and one
16 particularly that I like to point out that is kind of hidden
17 in the market development program support is the \$4 million
18 that we will be hearing more about a little bit later from
19 John Mough of the Department of Food and Agriculture,
20 Division of Measurement Standards, who is going forward on
21 Fuel quality Assessments for Hydrogen and a type approval
22 for a retail dispenser. So we will be hearing more about
23 that, but I want to make sure that is not lost in the
24 background noise here because that is something we have
25 already committed to, and we think it will yield positive

1 results as we go forward in the hydrogen area so we can
2 actually sell hydrogen at retail and make a better business
3 case in the future.

4 Our next steps are the ongoing evaluation of some
5 of the proposals, and especially meeting with those entities
6 that were successful under the federal solicitation, using
7 ARRA Investment Plan funding. And we will be preparing this
8 California based solicitation in accordance with the current
9 Investment Plan, the one that is in place. Why we are here
10 today is for the next Investment Plan that will cover years
11 2010-2011, so we will be finalizing those solicitations for
12 available funding, therefore, and releasing those very soon.
13 We will be updating the Investment Plan for Fiscal Year
14 2011; that is what we are about the business here today for,
15 and now we are hoping to be able to finalize that Investment
16 Plan right after the first of the year, within month of the
17 new year. Thank you very much for your attention and I look
18 forward to a very productive day. Thank you.

19 MS. BARODY: Thank you, Peter. Now I would like
20 to welcome Gerhard Achtelik.

21 MR. ACHELNIK: Good morning. Thank you. And
22 thanks for attending the California Energy Commission's
23 Investment Plan Workshop. I will be giving an overview of
24 the Zero Emission Vehicle Regulations, some of the drivers
25 behind hydrogen, the Zero Emission Vehicle Regulation and

1 other regulations like the bus regulations, SB 1505, all
2 the regulations currently in place at the Air Resources
3 Board that drive some of the need for hydrogen specific and
4 just electric drive technology, in general. And the goal of
5 all these policies and regulations are really two-fold.
6 Historically ground level ozone and PM were the primary
7 drivers for the Air Resources Board, but we have
8 transitioned or grown to include the greenhouse gas
9 emissions reductions, and the big goal is the 80 percent
10 reduction in 2050. And we are looking at these emissions
11 not just at the tailpipe anymore, but we are looking at them
12 both upstream and downstream on a rolled wheel emissions, so
13 the fuel production and the use of the fuel. And for
14 hydrogen, what the background for hydrogen, one of the big
15 drivers was the Governor's announcement in the State of the
16 State Address, and then also with the issue of the Executive
17 Order that directed the State, the Air Resources Board, the
18 California Environmental Protection Agency to work with
19 academia and other government agencies and business to
20 develop a blueprint plan. And out of the plan, this has
21 become an evolutionary sort of effort. The Governor, when
22 he announced this hydrogen highway effort, and we still get
23 pointed at a lot of times, we talk about the plan being a
24 goal to have a station on California's major highways at
25 periodic intervals, but even the blueprint plan already

1 pointed out that we are going to develop this hydrogen
2 infrastructure in a focused effort because the key thing is
3 that the infrastructure needs to be where the vehicles are,
4 and the blueprint plan came out and pointed out the
5 geographic areas where we first expected vehicles to be,
6 pointed at San Diego, the Los Angeles area, and the
7 Sacramento area. That would be the first deployment of
8 vehicles. And that is really what has proven true. And
9 what we have come to now, what the blueprint plan is focused
10 to now is we really are working now on clusters. We are
11 working on clusters within those geographic areas. Vehicle
12 placements are very targeted, and hydrogen infrastructure,
13 as a lot of you know, is still at an early stage, it is
14 still costly, and the volume is not there to be a profitable
15 station, but yet the stations are needed for the vehicles.
16 So we are now focused on clusters. The highway is still
17 there, it is just that we are building the highway in pieces
18 and just as our major interstates were not built overnight,
19 we did not put a million miles all over the U.S. in a day,
20 the hydrogen will develop in pieces.

21 The focus, I will show you on a later map, right
22 now we are still focused on three primary areas, which would
23 be the LA Metropolitan Area, the Bay Area, and the
24 Sacramento Area. Just a slide here on the greenhouse gas
25 emissions, are one of the major drivers for hydrogen is the

1 greenhouse gas emission reduction benefit, and you do get
2 criteria pollutant benefits, too. But, as Peter had
3 mentioned, a large single portion comes from the
4 transportation sector, so the driver for hydrogen is the
5 greenhouse gas reduction goals that can be achieved in 2050.

6 Here is a complicated regulation and a complicated
7 slide. But this represents 2012, and this is the Zero
8 Emission Vehicle Regulation for 2012, and basically a
9 manufacturer can meet all of their obligation by producing
10 zero emission vehicles. Since the technology is still in
11 development right now, and this represents 2012, the
12 manufacturers ZEV production requirements, whether it be 12
13 percent based on their annual sales, but the manufacturer
14 has some optional compliance strategies, and right now a
15 minimum of .79 percent of what they produce have to be the
16 purer ZEVs, which would be either fuel cell vehicle or
17 battery electric vehicle. And then we have the next
18 category, which is now the .79 is a minimum where these
19 other values represent maximums, meaning that the most --
20 especially at the 6 percent PZEV, actually, that is our
21 Partial Zero Emission Vehicle, and those represent the
22 traditional gasoline internal combustion engine, and also
23 represents the natural gas fueled vehicles, and that is a
24 car that is very clean, the emissions were estimated to be
25 roughly about equivalent to what you would get from charging

1 an electric vehicle, and drive 150,000 miles. And these
2 Partial Zero Emission Vehicles also have 150,000 mile
3 emission warranties, so that represents one way the
4 manufacturer can meet their ZEV obligations, and you step
5 your way up to ATPZEV, which represents the hybrids, and
6 actually that is where the Honda CNG vehicle fits in, and
7 the new category that was developed in the 2008 March Board
8 hearing was the Enhanced ATPZEV, and these vehicles will be
9 using zero emission fuels, so they will be using electricity
10 or hydrogen, so you could have the hydrogen internal
11 combustion engine vehicle in this category, or you have the
12 plug-ins, which we are expecting to start rolling out next
13 year. So the ZEV regulation is met through four different
14 paths, and the enhanced path, the enhanced ATPZEV segment is
15 what is now considered the ZEV enabling, or ZEV development
16 portion of the regulation.

17 The program has, although what started as a fairly
18 simple regulation and, as you saw on the glass, has become
19 pretty complex, it has been successful. We have had over
20 250 fuel cell vehicles deployed in California, or 4,700
21 battery V's and a very large number of neighborhood electric
22 vehicles, all of them developing to cleaner air, not to
23 mention even what I do not include in here, the large number
24 of Partial Zero Emission Vehicles, which have provided
25 tremendous emission reduction benefit.

1 So the program has provided a variety of cars
2 that we did not see back in 1990, and all the products have
3 an emission reduction benefit. And the program, the ZEV
4 Program, will continue to become a more focused research
5 under the development of battery electric vehicles and fuel
6 cell vehicles.

7 Given this complex structure, where do we think we
8 need to be? This slide here gives you an overview of
9 vehicle sales only. This does not represent the mix of the
10 fleet. But basically, in order to achieve the 2050 goals,
11 we need to have 100 percent of our vehicle sales in 2050
12 need to be either fuel cell vehicles, or battery electric
13 vehicles, and we expect hybrids and plug-ins, since they do
14 not give us the same criteria and greenhouse gas emission
15 benefits of the pure electric drive, their role will
16 decrease as we go out in time. This does not represent the
17 whole fleet. The whole fleet will also have, you know,
18 hybrids and plug-ins still in operation, and some biofuel
19 vehicles, but we expect the majority of the light duty
20 vehicles will be fuel cells or battery electric vehicles,
21 and biofuels, which is just like any other of our
22 transportation fuel, a limited commodity, and will primarily
23 be found in heavy duty application, and even airplane
24 applications. So, while biofuels will help us get there to
25 2050, we do not expect them to be the major role in 2050 in

1 the light duty field. And the initial curves are fairly
2 shallow. They are based around 4 percent of sales similar
3 to the current hybrids. This slide gives you both the
4 predicted and the required vehicle productions, and the top
5 row where it says required vehicles is just what the
6 regulation, as it stands right now, meaning that if a
7 manufacturer chose just a single path, this is the number of
8 vehicles they would have to apply that are the gold, or the
9 fuel cell, or battery electric vehicles. And this is
10 somewhat also depending on the type of vehicle they produce,
11 and the regulation gives credits based on the range of the
12 vehicle. And from the gold vehicle, gold fuel cell vehicles
13 on down, those are staff's anticipated roll-out of vehicles.
14 And this number -- what the regulation did in 2008, since
15 staff saw a surplus of credits, it sort of forced that these
16 credits be used early on, so you can see that, in our
17 current phase that we are in, we clearly have a lower number
18 of vehicles than what is required, but that is because of
19 the early production of vehicles that the manufacturers
20 prior to this time. So now those credits are being spent,
21 and the vehicle roll-out of new ZEV technologies is going to
22 increase. And these numbers are fairly conservative. In a
23 survey that the partnership did, they came with numbers that
24 were almost double, especially in the 2015-2017 timeframe.
25 These are sort of minimum numbers. And the program goals,

1 as ZEV II is being reviewed December 10th of this year, the
2 staff will go to the Board with a informational report, and
3 again, as a result of the 2008 hearing, the Board directed
4 staff to reevaluate the program and to harmonize it with the
5 other regulations such as Pavley and LEV III. One of the
6 things you see here is that vehicles that were in the ZEV
7 regulation, like hybrids and the Partial Zero Emission
8 Vehicles, the clean gasoline vehicles, PZEVs, will move into
9 what will become LEV III. And the ZEV regulation will move
10 towards developing the ultra low carbon technologies, the
11 electric drives and the -- well, electric drives, be they
12 energize just through batteries or hydrogen. The scale will
13 be to assure that we can get the 80 percent reductions by
14 2050. And in order to get there, we need to start seeing
15 significant numbers, in the tens of thousands, as was seen
16 starting with the 2015 model year.

17 In addition to the Zero Emission Vehicle
18 Regulation, we also have the Zero Emission Bus Regulation.
19 And we have had eight fuel cell buses in operation in
20 California. Three of them are still in operation here in
21 the Oakland Bay Area by AC Transit, VTA, each operated
22 three, and those buses are just in special service now, but
23 AC Transit buses are in daily service, serving on scheduled
24 routes, serving their customers. And some light transit,
25 which is not a regulated, AC is also operating a fuel cell

1 bus. And starting in -- well, actually starting late this
2 fall, we will see the first buses of the 12 bus
3 demonstration being deployed in the Bay Area, and in this
4 case, while AC Transit led the three bus demonstration with
5 Golden Gate Transit, all five Bay Area Transit Agencies will
6 be participating in this 12 bus demonstration, and will
7 actually be sharing these buses at times. And we are
8 looking forward to that. We expect all 12 buses to be in
9 operation by the third quarter of next year. But, again,
10 this points at a need for hydrogen. The purchase
11 requirement, which is right now on the books, starting in
12 2011, is in review, and we expect to delay that a couple
13 years. But there is a definite near term demand to meet the
14 hydrogen demand for these 12 buses.

15 The production of hydrogen was required through
16 the Legislature to meet some very strict environmental
17 standards and it includes the criteria pollutants at 50
18 percent reductions for NO_x and ROG, which is actually -- that
19 is relatively easy for hydrogen to achieve, just almost just
20 freezing hydrogen, and this is a well to tank analysis,
21 meaning we are not even getting the benefits of having zero
22 emissions, we are comparing this to a vehicle, but yet we
23 are not even counting here the benefit of having zero
24 emission miles while driving the car. The way the
25 legislation is written, it required a 50 percent reduction

1 strictly well to tank. So, even just the production of
2 hydrogen from natural gas is cleaner when compared to
3 gasoline vehicle operation. It requires a 30 percent
4 reduction of greenhouse gasses on a well to wheel, no
5 increases in toxics, and this is an item we will be going to
6 the Board with likely in June or July of next year.

7 The challenge for the hydrogen regulation is the
8 33 percent production of renewable sources. And what that
9 means is 33 percent of the energy required to make hydrogen,
10 so if you make hydrogen from natural gas itself, you could
11 not meet the renewable requirement, you need to include some
12 biofuels, or you need -- and you could blend that with
13 taking all the electricity that you used from renewable
14 source. But, just the electricity demand for hydrogen
15 production from natural gas would not be sufficient, that
16 would get you about, oh, two-thirds of the way there, it
17 gets you about 20 percent. And the regulation applies --
18 the renewable requirement -- all of these criteria -- but
19 the renewable requirement is the challenging one, applies to
20 all stations that are co-funded by the state. And it will
21 kick in to all hydrogen production and warrants a threshold
22 of 3,500 metric tons per year has been exceeded. And there
23 are some exemptions, but until the Board actually approves
24 those, and gives the Executive Officer the right to
25 implement those exemptions, they are not in effect. What is

1 in effect is the emission reduction requirements. The
2 Clean Fuels Outlet Regulation is currently another
3 regulation that has been on the books since 1991 and it was
4 developed back then because it was believed that traditional
5 gasoline vehicles could not meet the emission reduction
6 goals that were required to meet the Ambient Health Quality
7 Standard. But that has since clearly been disproven, the
8 auto manufacturers are making incredibly clean gasoline
9 vehicles, so now we are looking at potentially revising this
10 regulation. We are going to the Board in December with an
11 informational report, and that we will be studying the
12 development of infrastructure. Right now, the trigger is
13 based on 20,000 vehicles and, for hydrogen, and battery
14 electric drive vehicles, that number is too large because,
15 as they vehicles are deployed in the early phases, to reach
16 the 20,000 trigger without established infrastructure, is
17 not synchronized, will not work, so we are looking -- if we
18 have to revise the regulation, we will be looking to lower
19 that trigger. And what our objective will be is to assess
20 over the coming year if the state funding will be used to
21 deploy infrastructure, or if we will need to use the stick,
22 I guess, will the carrot work, or will the stick work? That
23 is one of our challenges for the next year. But the Clean
24 Fuels Outlet will be focused on achieving the 2050 goals, so
25 the fuels we will be looking at will be those fuels that

1 will get us to the 2050 goals, and we will be looking at,
2 to the extent that the infrastructure is a hurdle to the
3 deployment of the technology. So, with hydrogen, that is
4 clearly a definite case because the cost of that
5 infrastructure is prohibiting a lot of smaller companies
6 from jumping into that. So, if needed, we will update that
7 regulation late in 2020 in coordination with the ZEV II
8 Regulation.

9 The Low Carbon Fuel Standard was adopted by the
10 Board earlier this year and, as it stands, it looks at -- it
11 requires the manufacturers, as Peter said, to reduce their
12 carbon fuel by 2020 by 10 percent, and it is a graduated
13 scale where the incremental reductions required an increase
14 as you approach 2020, and it starts off relatively slow in
15 the next year. And just as a point of reference, for
16 hydrogen, one estimate is it would be the carbon value is
17 maybe \$50.00 per metric ton. Right now, in the near term,
18 we suspect the driver for Low Carbon Fuel Standards will be
19 the biofuels and not hydrogen and electricity, but that is
20 something we are going to have to track and see how it
21 actually spells out.

22 The interaction of the regulations -- the Zero
23 Emission Vehicle Regulation requires a minimum number of
24 vehicles, so therefore incentives, both the Air Resources
25 Board and the California Energy Program have vehicle

1 incentive programs, and so incentives to vehicles are okay
2 because it is the vehicle production that is regulated, and
3 not the purchasers. So incentives to the purchasers can be
4 provided. For the hydrogen production, if funding is
5 provided for the production of hydrogen, you could still
6 earn Low Carbon Fuel Credits. There is no restrictions on
7 using credits from a station that was mandated by a clean
8 fuel outlet regulation if we were to develop a clean fuel
9 outlet regulation because, again, it is a station
10 requirement, not a specific fuel production requirement.

11 The AB 118 funding -- so this is where we are
12 saying that, if the fuel is subsidized, you cannot get
13 credits, but if the station is subsidized, you could earn
14 credits. If the clean fuel outlet is adopted, only the
15 renewable portion of the AB 118 funding could be supported,
16 not the actual building of the station. So it is a complex
17 complex picture, but the regulations do interact, obviously.
18 And so funding is available to vehicles and hydrogen
19 production, and then, in the future, depending on what we
20 see developed, some of the funding for stations might not be
21 available anymore.

22 Where do we stand today? Peter did point out that
23 this is the Investment Plan for the 2010-2011 timeframe, but
24 one thing to keep in mind, where we are today is you are
25 looking at the hydrogen needs, this is where we are today,

1 and to date no funding for stations has occurred through AB
2 118, so you look at your need from this point forward, this
3 is a map I borrowed from the partnership, and we have four
4 stations that we consider public access stations. There are
5 more stations than that in California, but these are the
6 four in Southern California that we consider public access.
7 It would be UC Irvine down South, and the orange stations on
8 this map are the public access -- Santa Monica, Burbank, and
9 South Coast AQMD. This is what we consider the public
10 access stations. So the Burbank one is actually in jeopardy
11 of remaining open, and then the green stations are the ones
12 that have been funded in the South by the Hydrogen Highway
13 money through the Legislature in the past, and those are
14 currently being built, and we expect those to open in 2010,
15 next year. And while this map only shows Southern
16 California, we do have two projects in the San Francisco Bay
17 Area, one is at the airport and one is in Emeryville. And
18 the Emeryville station is co-located with the Transit
19 Agency, they actually have one side of the station will fuel
20 cars, and then the other side will fuel buses, which is a
21 pretty exciting opportunity. And there is a additional
22 demand needed in Northern California. Now, I just showed
23 this to Southern California because that is the only map
24 that I have prepared so far and it is partnership prepared,
25 so I will have to steal another one from them later when

1 they get the next one. But this is the start of our
2 highway. We can see the start of our highway is the 405
3 corridor. We can go from UC Irvine, Newport Beach, up to
4 Santa Monica, and we are looking to grow. So here is the
5 start of our highway. Now, we are going to work from that,
6 that is part of the Investment Plan is how we grow this
7 plan. And then, in another slide I borrowed from the
8 partnership, is we are now at the early phase, we are at the
9 bottom of this curve here where hundreds of vehicles -- we
10 are going to tens of buses, and we are just starting a
11 handful of retail stations, and we are growing forward. We
12 expect thousands of vehicles and we expect a number of buses
13 to grow. Even with the station we funded at AC Transit, an
14 additional station will be needed because then upgrades will
15 be required to the station they have in Oakland. So we are
16 looking to grow. There is a definite need for
17 infrastructure. And I think that is my last slide.

18 There are links to all these programs on our
19 website, and look for updates and look for changes. Thank
20 you.

21 MS. BAROODY: Thanks, Gerhard. We actually have
22 about five minutes for any questions.

23 MR. OLSON: I have one. Gerhard, I wonder if you
24 could provide a source, the data for your vehicle -- in your
25 slide, I am not sure whether your slide was a compliance

1 schedule, or whether that was just tracking right there.

2 MR. ACHTELIK: This one?

3 MR. OLSON: Yeah. And then the one prior to that,
4 a couple prior to that.

5 MR. ACHTELIK: Okay. This is a compliance
6 schedule here. This is what the first line -- the required
7 vehicles is what the regulation requires. And the second
8 line, the gold fuel celled vehicles, is what we expect to
9 happen based on Management and staff's meetings with the
10 OEMs. And all of these allow -- like the glass slide that
11 said you do not have to build -- you do not have to meet 100
12 percent of your reserve requirements strictly through the
13 pure gold category, so you can see that there is a lot of
14 silver plus vehicles which represent the plug-ins and silver
15 and bronze. Now, this slide represents the regulation as it
16 exists today. The 2015 numbers could change with ZEV II,
17 where the bronze and silver will disappear out of the ZEV
18 portion and go on to Pavley, and into LEV III. But we do
19 not expect the required vehicle numbers and the fuel cell
20 vehicle numbers to decrease because the Board has been
21 pretty consistent about requiring the gold vehicles. And in
22 the last March hearing, just as an example, the Board
23 basically doubled the vehicle numbers that were required
24 from what staff recommended.

25 MR. OLSON: And can you go back a couple? That

1 slide and you had one previous. So --

2 MR. ACHTELIK: This is -- the achievements?

3 MR. OLSON: No, the next one.

4 MR. ACHTELIK: Okay.

5 MR. OLSON: So your legend there --

6 MR. ACHTELIK: Yeah, this is -- what this
7 represents is a projection of -- it represents the vehicle
8 sales we have to have in order to achieve our 80 percent
9 reduction goals and, actually, this graph only gets us to 70
10 percent in 2050, that in order to achieve the 80 percent
11 reduction, we actually need an earlier and steeper kick-off
12 for fuel cell vehicles and battery electric vehicles, but
13 the initial kick-offs on these curves represent, you know,
14 where the lines are flatter, they are based on how hybrid
15 vehicles accelerate.

16 MR. OLSON: Yeah, so I am trying to do a quick
17 comparison of the Alternative Fuels Plan which had a
18 different kind of scenario for 2020.50.

19 MR. ACHTELIK: Well, I think these are sales only,
20 not the cumulative vehicle fleet. Now, the Alternative
21 Fuels Plan showed fuel cell vehicles, plug-ins, hybrids, and
22 natural gas vehicles out still in 2050, but what we are
23 saying is that, in 2050, you cannot have sales of those
24 vehicles and expect to meet the greenhouse gas emission
25 reduction goals at that time.

1 MR. OLSON: And so, did the Board adopt this
2 analysis?

3 MR. ACHELNIK: No.

4 MR. OLSON: Can you also explain, just go back and
5 you made a comment about if fuel is subsidized, you cannot
6 gain credits, but you can for the fueling. Can you just
7 elaborate on what you meant by that? Is that AB 32 credits?
8 Is that financial credits? Is that kind of policy credits?

9 MR. ACHELNIK: These would be -- okay -- this is a
10 combination of -- my understanding and speaking with
11 Management, what are the bounds for both AB 118 and the Low
12 Carbon Fuels Program, and so what we have here -- it is my
13 understanding is AB 118 cannot be used to fund a required
14 program. And so, what this represents is that if, instead
15 of funding the building of a hydrogen station, and the
16 operation of it, you will just give a direct subsidy to the
17 hydrogen, say, whatever, you know, a dollar per kilogram
18 subsidy. Then you could not earn Low Carbon Fuel Standard
19 Credits. But if you subsidized the building of the station
20 and the operation of it, you are not paying for the fuel
21 directly, so then you could still earn Low Carbon Fuel
22 Standard Credits.

23 MR. OLSON: Yeah, there is that, so as you
24 explained, the Low Carbon Fuel Standard has kind of a
25 staggered Implementation Compliance Schedule.

1 MR. ACHTELIK: Yes.

2 MR. OLSON: So if we funded something that, say a
3 fuel production type of project that is an early action
4 before it is required, what is your timeframe for
5 determining what constitutes early compliance?

6 MR. ACHTELIK: You can fund the production of
7 hydrogen; that is alright. But you just cannot fund -- you
8 cannot give a direct subsidy to the hydrogen, so even when
9 the Low Carbon Fuel Standard regulation kicks in, you can
10 still fund the production of it.

11 MR. WARD: Wouldn't that be complied with 1505 if
12 we did, though?

13 MR. ACHTELIK: Well, 1505 requires -- 1505 in a
14 sense allows the funding of renewable hydrogen because it
15 requires any state funded hydrogen to have a renewable
16 component. So 1505 in a sense creates a conflict, but if it
17 came first and it required that state funds be used for
18 renewables --

19 MR. WARD: And that is an existing requirement
20 right now, though. Right?

21 MR. ACHTELIK: Yeah, 1505 is in legislation, it is
22 a law, and it is just we have not developed the regulation
23 that helps implement it.

24 MR. WARD: Do you have plans for the development
25 of a regulation to implement --

1 MR. ACHTELIK: Yeah, we are looking for June or
2 July of 2010, the Board hearing date.

3 MR. WARD: I noticed also that in the ZEV, you may
4 be pushing back from 2011 -- you mentioned, when you go to
5 your Board that it may be -- is that basically expanding the
6 window of early opportunity -- two more years?

7 MR. ACHTELIK: I will go back -- I am not sure --
8 the regulation as it -- our expectation, the regulation is
9 set through 2014, and when we go to the Board, what we are
10 expecting is that the Board will direct staff to start
11 changing the Reg, starting from 2015, and what we expect to
12 see is that the silver and bronze categories will be removed
13 from the ZEV regulation.

14 MR. WARD: Maybe I was referring to the Zero
15 Emission Bus Program.

16 MR. ACHTELIK: Yeah, okay, yeah.

17 MR. WARD: The purchase requirement was in 2011 --

18 MR. ACHTELIK: Right.

19 MR. WARD: -- and it may be pushed back two years.
20 Does that expand the window of opportunity there?

21 MR. ACHTELIK: Yes.

22 MR. WARD: I guess what I am -- this is kind of a
23 floating window of opportunity at this point, depending on
24 what your Board does.

25 MR. ACHTELIK: Yeah, it will be -- right now, our

1 goal also is, in late 2010, to set a new either purchase
2 date or bus performance technology date criteria, and so,
3 yes, that will be delayed to, you know, if I am guessing
4 right now, 2013. And in part, because what we are really
5 waiting for, there are two big demonstrations in the winter
6 of 2010, the Olympics will be taking place up in Vancouver,
7 and they will deploy a 20 bus fleet, and then starting some
8 time the third quarter of 2010, we will have the 12 bus
9 demonstration in the Bay Area, and they will be all 12
10 buses, and that is the data that we are going to rely on to
11 let us know how far the technology has progressed and what
12 our next steps should be. So did that answer your question?

13 MR. WARD: Actually, I think it did. What I guess
14 I am also getting at, in general, and if you can give us a
15 rule of thumb, the regulations that would be coming in to
16 play, I think you folks have a rule of thumb that it is in
17 here, or six months, or something prior to that, that early
18 actions can be afforded without running up against the
19 prohibition we have in our program to not fund any obligated
20 party for a regulation mandate or law. Is that a rule of
21 thumb at six months, or a year?

22 MR. ACHTELIK: I will have to look into that. I
23 do not know.

24 MR. WARD: Thank you.

25 MS. BAROODY: Well, thank you, Gerhard. We

1 appreciate you taking the questions. All right, next we
2 have John Mough with Department of Food and Agriculture.

3 MR. MOUGH: Thank you for the opportunity to be
4 here today. I am John Mough. I am a Chemist with the
5 California Department of Food and Agriculture, their
6 Division of Measurement Standards.

7 What is going on currently is we have got the
8 transition from demonstration stations to commercial
9 stations. We are establishing national state codes for fuel
10 dispensing device requirements, the method of sale, and the
11 fuel quality. Draft codes have been developed by the U.S.
12 National Working Group for Commercial Hydrogen Measurement,
13 they have been introduced to the Regional Weights and
14 Measures Associations, that happened last week in Las
15 Cruces, New Mexico. Draft codes are there for the device
16 design specifications, the method of sale, how we are going
17 to sell this product, which is going to be by the Kilogram,
18 and for advertising and labeling requirements for the
19 dispensers and stations. They are also working on fuel
20 quality specifications, which are taken from the draft SAE
21 Technical Information Report and the current California
22 Regulations. The National Weights and Measures Standards
23 Development Organization are the people who are in charge of
24 developing standards -- the National Conference on Weights
25 and Measures. They will review the draft codes that were

1 just proposed in January 2010, and they will vote in July
2 2010 on these codes. The model codes and standards must be
3 adopted by each state to become enforceable. Now,
4 California adopts these regulations by reference, so they
5 will automatically written into California law, but for any
6 adjacent states, or any other states in the U.S., they must
7 adopt these in their own laws. Also, the device code will
8 not be enforceable, it will be a tentative code for the
9 first couple of years. It will not be enforceable until it
10 becomes a final code. And in California, the Division of
11 Measurement Standards will have to write California
12 regulations for the device design, the method of sale, and
13 we already have the first fuel quality specifications in the
14 country.

15 The people that we have been working with on the
16 fuel quality specifications are ASTM in terms of developing
17 the test methods to measure the contaminants, the SAEJ2719
18 Committee, and International Organization Standards, they
19 have a draft out right now of 14687-2 for PAM (phonetic)
20 fuel cells. It is interesting right now, the California
21 regulations that we have in place, the SAE specification
22 with the Technical Information Report, and the ISO Standard
23 are all harmonized. So what is going on here in California
24 is the same that is going on across the United States and
25 throughout the world.

1 Current work at DMS is going on is the current AB
2 118 Investment Plan gave \$4 million to DMS to research and
3 develop the fuel sampling procedures because we needed to
4 make sure that when we go out and take a sample that we have
5 a manner of doing it which is truly representative of the
6 product that is being sold to the public, and that everybody
7 can take a sample in the identical manner, so anybody can go
8 out there and take a sample and be assured of the results
9 they are getting. We are also working on the laboratory
10 analytical methods and the fuel dispenser testing methods,
11 and the test methods for testing the dispensers. The Inter-
12 agency Agreement between the Energy Commission and DMS is
13 being finalized as we speak, it has been kind of a long
14 tortuous process, but hopefully it will be within the next
15 couple of weeks that will all be wrapped up.

16 For part of the next Investment Plan, we would
17 like to see the validation of analytical procedures.
18 Analytical procedures can be developed, but they are not
19 valid until what is called the Round Robin study has been
20 done on that, where a number of laboratories that routinely
21 perform this analysis take a sample, test it, and inter-
22 compare their results to see what is the standard error in
23 the test measurement. That gives us, then, numbers that we
24 can use to set guidelines for the enforcement standards.

25 We need to really establish a permanent fund for

1 alternative fuels. The problem is, the funding for the
2 fuel quality program is not to be used for alternative
3 fuels, so our current existing Motorola Assessment Feed that
4 funds our Petroleum Product Program for the Division of
5 Measurement Standards, it is not to be used for alternative
6 fuels. The funding for dispenser evaluation is paid for by
7 manufacturers who submit a prototype dispenser for
8 certification. It is not enough to pay for development of
9 new test methods and procedures. And general funds pay for
10 the dispenser testing program currently, and that keeps on
11 shrinking. Traditionally, it is county weights and measures
12 employees who test fuel dispensers, retail motor fuel
13 dispensers, but they have no expertise in testing new
14 equipment.

15 Here are some useful links. The first one to the
16 NIST, Weights and Measures Division, the proposed draft code
17 for the devices is under the link through the U.S. National
18 Working Group, National Conference on Weights and Measures,
19 so the people who will be adopting those specifications, and
20 here is something to our website, and then here is contact
21 information for who you need to see at DMS. I am the
22 chemist in charge of fuel quality requirements, Kristin
23 Macey, she is the Assistant Director, she is on the U.S.
24 National Working Group and on the National Conference of
25 Weights and Measures, and Mr. Dan Reiswig, who is the

1 Manager of the California Type Evaluation Program. That is
2 it.

3 MS. BARODY: Thank you, John. Are there any
4 questions for John?

5 MR. OLSON: John, this is Tim Olson with the
6 Energy Commission. I wondered if you could just elaborate
7 on, well, my understanding of this process is that the fuel
8 line stations cannot sell hydrogen until this process is
9 completed. And can you give us an estimate of what that
10 timeframe would be?

11 MR. MOUGH: Currently, no fuel dispenser
12 manufacturers have submitted any prototypes to us for
13 evaluation. What their timeline for doing that is, is
14 unknown. If we were to receive one today, we would take it
15 through a draft code, since the National Conference on
16 Weights and Measures has not adopted any code, we would have
17 to use a modification of the procedure that we use for CNG
18 dispensers at this time. But we would be happy to see any
19 dispensers that came in and evaluate them. I would imagine
20 that the timeframe to get the evaluation done would be on
21 the order of six months.

22 MR. OLSON: And another question on the -- as you
23 go through this process, how do you distribute the
24 information? How do the implementers understand how to use
25 your standard? Do you have a training program? And,

1 frankly, I am not sure if this was part of our interagency
2 agreement, but if it is local Weights and Measure people who
3 monitor and implement this type of program, how do they get
4 that information?

5 MR. MOUGH: The Division of Measurement Standards
6 has a rigorous training program throughout all the counties
7 in California. So they will be trained on how to do it on a
8 pretty much as needed basis. As Gerhard pointed out, it
9 looks like the first concentration is going to be in the LA
10 area, San Diego, San Francisco Bay Area, Sacramento Areas.
11 So the affected counties with those dispensers would be the
12 first that we would target for training on how to evaluate
13 the dispensers.

14 MR. OLSON: And in your recommended actions for a
15 future Investment Plan, do you have any estimated costs for
16 those items you had on your list?

17 MR. MOUGH: No, I do not, but I would be happy to
18 round up some numbers and get them to you.

19 MR. OLSON: Very good. I appreciate it.

20 MR. ACHTELIK: This is Gerhard Achtelik. I have a
21 question, too, John. In your current funding, does that
22 include the cost of the actual hydrogen quality test in your
23 development of the standard, or if a station was to call you
24 up to have the quality of their hydrogen evaluated, is
25 actual testing included in that?

1 MR. MOUGH: There is some funding in there to do
2 the actual testing. Because the test methods have not been
3 standardized and finalized yet, and no validated test
4 methods -- there are some draft test methods out there, none
5 of them have been validated, we could not take any
6 enforcement one way or another. The testing that we do, the
7 numbers will be available to the hydrogen community.

8 MR. OLSON: One other question, John. I heard you
9 say that this process in July of 2010, each state needs to
10 go through an adoption process. Does that imply that, if we
11 go through an adoption, that we have to wait for other
12 states before we can actually implement our program?

13 MR. MOUGH: No. California adopts the National
14 Conference of Weights and Measures by reference in their
15 laws, in our laws, we adopt it by reference. Several other
16 states do not. For example, Connecticut, which is looking
17 and moving forward on some of the hydrogen infrastructure
18 and hydrogen highway, does not adopt them by reference. So
19 it will be kind of a piecemeal process as it moves across
20 the United States. What we found so far in the hydrogen is
21 that, what happens here in California is pretty much what
22 happens throughout the rest of the United States. No other
23 state in the United States has developed any hydrogen
24 specifications yet, we are the first state to do that. It
25 is my belief that most other states will just adopt our

1 specifications pretty much by reference.

2 MS. BARODY: Okay, John. Thanks for your time
3 today. I appreciate it. Well, we will move right on to our
4 Light Duty Vehicle Panel. And I would like to introduce
5 Bill Elrick of the California Fuel Cell Partnership, and he
6 will be introducing our speakers today.

7 MR. ELRICK: Okay, thank you. Thank you for the
8 opportunity to speak with you today. As the California Fuel
9 Cell Partnership, a member organization with industry in
10 government, educational, transit agencies, I want to give an
11 update first on where we see the industry now and over the
12 next couple of years. So I will jump in without some
13 slides. What I want to show you first --

14 MS. BARODY: Oh, hold on just a second. Pilar is
15 getting a presentation ready.

16 MR. ELRICK: Thank you. Great. What I want to do
17 is, I know you have seen some of this information before,
18 but to review the Action Plan which was developed last year
19 by the collection of industry and government partners. This
20 plan explicitly outlines how we plan to move from this
21 demonstration phase that we are exiting from, and through
22 the Valley of Death, and into the commercial market. It
23 calls for 40 new, in support of six existing stations. It
24 focuses on three areas; they are light duty passenger
25 vehicles in LA, transit buses in San Francisco Bay Area, and

1 development of necessary regulations, codes, and standards
2 in the Sacramento Region. Altogether, the plan was
3 developed to move us through 2014, and requires
4 approximately \$180 million by both industry and government
5 together. The \$40 million outlined in the CEC Investment
6 Plan will continue California's leadership in this area, and
7 move us purposefully into this commercial market. And it is
8 very important that California remains the world leader in
9 this area, not just because of the energy and environmental
10 benefits that they offer, but so that we retain and expand
11 the job creation and the economic benefits that the
12 technologies offer.

13 Through 2014, automakers expect to place 4,300
14 light duty fuel cell vehicles in California. Most of these
15 vehicles will be located in Southern California,
16 concentrated in four communities of Los Angeles, those are
17 Santa Monica, Irvine, Torrance, and Newport Beach. The
18 Action Plan is designed to meet the needs of these 4,300
19 vehicles, while also building the foundation for meeting the
20 needs of the almost 50,000 vehicles planned through 2017.
21 We are now actually finishing the local community-based
22 Action Plan, helping these communities so that they are
23 working from the ground up, it is based on the Clean Cities
24 Program.

25 Turning now to transit, the San Francisco Bay Area

1 Program is a unique collaboration of five transit agencies,
2 and they are moving forward to jointly own and operate 12
3 fuel cell buses, with funding and support from the FTA,
4 these buses will soon serve passengers throughout the Bay
5 Area. This program will be the largest of its kind in the
6 United States and it is closely watched by FTA as a crucial
7 part of their electric drive strategy. By 2014, the
8 consortium could have up to 60 buses in operation. This
9 area, the San Francisco Bay Area Region, will also serve for
10 up to 700 light duty fuel cell vehicles by the 2014 time
11 period.

12 The third focus area is regulatory. California is
13 the first state to regulate hydrogen as a transportation
14 fuel. As John just pointed out, the California Department
15 of Food and Ag's DMS Group and other regulatory bodies are
16 creating those regulations, processes, and procedures
17 required to sell hydrogen as a retail fuel. Transparent
18 access to a state-of-the-art station in the Sacramento area
19 is vital to their success, and that is included in this
20 Action Plan. The commercial success of all the stations in
21 the industry throughout not just the state, but even the
22 U.S., will depend on their work.

23 So the question is, since the Action Plan released
24 last year, are we making any progress? On the vehicle side,
25 we are very close to the planned number of vehicles for the

1 end of this year. This data is from actually June of this
2 year, so by that time we were right on track, and this is in
3 spite of the economic downturn. In the case of transit
4 buses, the 12 vehicles described earlier are on the plan to
5 be deployed both the end of this year and the beginning of
6 next, with the whole operation.

7 We are also seeing progress in the new station
8 development, with the seven state funded stations and
9 several private industry stations in various states of
10 construction. These stations are now following the Action
11 Plan's cluster approach developed from our early
12 experiences. We learned that the hydrogen highway must
13 start somewhere, and in this case, it is along the 405
14 Freeway in Los Angeles. This is similar to the development
15 of the first freeway in the U.S., a few miles of road that
16 stretched between Pasadena and Los Angeles, and now
17 stretches over every reach of the United States. Several of
18 these stations further illustrate the transition to
19 commercialization, with hydrogen equipment being deployed in
20 existing conventional gas stations. One of these is even a
21 new independent operator that was funded through the state
22 assistance.

23 Progress to date on the regulations, we talked
24 about the SAE standards, they are going to bow it, as John
25 said, we do have the CHAP process which is based on the

1 Clean Cities with a local community outreach plan for
2 getting the grassroots, so we have top down and bottom up
3 approach. We have been working closely with DMS on their
4 needs, holding station builders' workshops and other
5 outreach activities so that we get all the different players
6 and stakeholders on the same page. We have even started to
7 create a mobile application to get real time station status
8 so that the early users, when there is still limited
9 infrastructure, know before they drive to that station, if
10 it is online, how much fuel is available. So we are
11 building all the different pieces and putting all the people
12 together so we make sure this is a success.

13 Okay, we see here as the previous demonstration
14 stations, listed here as existing supply, are phased out and
15 the newly funded stations come on line, that we are able to
16 meet the infrastructure needs for the next few years.
17 However, as vehicle deployment grows and we move from
18 hundreds to thousands of vehicles, we need to plan and
19 support additional hydrogen infrastructure. These next few
20 years are critical to this long term success. Supporting
21 the early infrastructure network until a critical mass of
22 vehicles arrives, with OEM's planning for the commercial
23 models around 2014-2015, and later reaching tens of
24 thousands of vehicles by 2017, now is when these early
25 station operators, most of them small local businesses, need

1 this government support. Once through this Valley of
2 Death, government support will not be as crucial and the
3 market will begin to pull additional stakeholders into the
4 game.

5 So are we ready to move forward with hydrogen fuel
6 vehicles? The vehicles are ready and you will hear next
7 from the OEM's since they are moving from these R&D
8 demonstration stages into commercial deployments. Large
9 energy companies such as Shell and Chevron, and new start-up
10 and independent businesses such as Propel, are moving
11 forward in partnership with government with station plans.
12 Government such as the hard work done by the CEC in their
13 Investment Plan, and the U.S. Congress and DOE recent
14 recommitting to the industry partners, are moving forward.
15 New players are also entering the market both here in
16 California and the U.S., such as Linde coming to compete
17 with some of the existing equipment providers. They are
18 building larger and commercial stations now, so the
19 equipment makers are moving forward. We are seeing other
20 fuel cell applications, forklifts, stationary applications,
21 and back-up power showing early market success. Some, like
22 Horizon, which made a profit by selling small hydrogen fuel
23 cell model kits have now expanded their plans and have
24 recently announced new vehicle plans, full scale light duty
25 vehicles in the European markets. They are moving forward.

1 Industry is on track to meet, or exceed in many
2 cases, nearly every benchmark set up by the Department of
3 Energy. The technology is moving forward. But most
4 importantly, industry, all the stakeholders, the automakers,
5 the equipment providers, the transit agencies, and
6 government have clearly outlined a plan to move forward and
7 are committed to this in the Action Plan. There is no
8 question, we are ready to collectively make hydrogen fuel
9 cell vehicles a commercial success.

10 That is what I wanted to do, outline just really
11 quickly the Action Plan and what we did as an industry to
12 get here. If you have any questions before we go to the
13 OEMs.

14 MR. OLSON: Thanks, Bill, for a good presentation.
15 I wonder if you could just elaborate on a couple slides
16 there. So, for example, your demand table, I do not know if
17 you can go back to that. The question I have -- right there
18 -- you have got the row that says "recently funded supply,"
19 that in 2014 goes from 680 to zero, is that the ARB --

20 MR. ELRICK: Those are the ARB stations, so they
21 are not the private stations right now, and the reason it
22 goes to zero is we were very conservative in this plan, and
23 when the stations, even though right now we are seeing a
24 difference where the early DOE demonstration stations are
25 ending up this year, they are starting to close because

1 there is no funding moving forward, we are working on
2 keeping some of those open once it makes sense. We do not
3 have, cannot say that in 2014 we have secured funding to
4 keep going. We think, at that point, we will start to see
5 more of a market pool and be able to do that, but we were
6 very conservative and said, "At this point, we do not know."

7 MR. OLSON: So that 680, that means that the
8 capital costs are covered, but operating costs are not in
9 2014? Is that --

10 MR. ELRICK: Yeah, by that time capital costs have
11 already been paid for from the beginning, but there are no
12 ongoing operational maintenance costs.

13 MR. OLSON: And what do you estimate that to be
14 for those stations?

15 MR. ELRICK: It depends on the size of the station
16 and the type of station, and I hate to say "it depends," but
17 it could be anywhere around \$200,000 a year, depending on
18 the type.

19 MR. OLSON: And you have another slide that was
20 your Action Plan rollout for vehicles, going back. I think
21 it was -- that was one of them, maybe that -- yeah, right
22 there. Do you have a breakdown of the clusters for Northern
23 California somehow?

24 MR. ELRICK: Yeah, in the Action Plan, the full
25 plan, which we can make available, or have made available,

1 it breaks down many of those communities.

2 MR. OLSON: It would be good if you could put that
3 into our record.

4 MR. ELRICK: Absolutely. It is one of your first
5 Investment Plan records, but we will resubmit it.

6 MR. OLSON: And the date of this -- when did you
7 do the survey?

8 MR. ELRICK: The last survey was 2008. We do it
9 actually twice a year, a less comprehensive survey. We are
10 actually gearing up right now for the '09 survey and we can
11 have that by the beginning of 2010.

12 MR. OLSON: So is it possible that some of the --
13 because of the economic downturn in the last year, that some
14 of these numbers might change?

15 MR. ELRICK: They might. We will see when they
16 come. I think we will have to hear what the OEM's say next,
17 but I can say that the early feedback is they do not change
18 much at all. But we will know in a few months.

19 MR. OLSON: Okay, thanks a lot.

20 MS. BAROODY: Thank you, Bill. Now, would you
21 like to introduce our light duty panel now?

22 MR. ELRICK: Absolutely. First, we have Alex
23 Keros from General Motors.

24 MR. KEROS: Good morning. I am not sure who
25 actually created the agenda, but I would like to thank them.

1 I am in sort of a weird spot, they usually put me after
2 lunch. Obviously, I am a pretty passionate guy and excited
3 to be here. So today is a big day, actually. Somewhere
4 across the United States, there is an initial DOE
5 subcommittee appropriations vote going to ballot, I believe,
6 later this evening, which is pretty neat, and I would like
7 to echo Bill's comments, where I would say a couple months
8 ago I think many in this room were scrambling. We were
9 facing a zero funding situation, perhaps negative funding
10 situation. Most of the people in this room sort of had a
11 call to arms and went and did something about it, and I know
12 what is sitting on this vote today is actually a plus
13 number, one that looks to the future for hydrogen. So it is
14 pretty neat. I think we are here and I would call it a
15 renewed focus, and to use this focus wisely and really
16 expand the industry. So excited to be here.

17 Many of you have seen this slide, if not from
18 General Motors, the fact remains it still applies. This is
19 our alternative fuel vehicle strategy, if you will, our sort
20 of "Let's Get Ourselves Off Petroleum" strategy. I was
21 thinking, there is a magazine that used to come out called
22 "Horseless Age," right? About 100 years ago? Who is going
23 to make up a name for the next magazine? It is like
24 "Gasolineless Age," or what not? But certainly we are
25 talking about the right-hand side of this slide and, really,

1 GM has continued to remain committed to fuel cell vehicles,
2 along with a host of other technologies. We like to say,
3 "You pick the technology, we can build it," and, really,
4 that is the focus. Today, let's talk a little bit about
5 that right side.

6 So, really, what we are looking at is continued
7 sort of interest in GM's program. People have heard me talk
8 about it, we have launched our first vehicle two years ago,
9 September of 2007, we took delivery of it. And all the
10 engineers were like little kids. I can tell you, after two
11 years, we are still like little kids, we love the cars. The
12 people who drive the cars are extremely interested. Over
13 80,000 people have raised their hand on this program in the
14 three target locations of Los Angeles, California, New York,
15 and D.C., 116 vehicles have been on the road, continue to be
16 on the road in four countries, a majority of those vehicles
17 are out of our hub in Burbank. We have deployed a little
18 bit up here to support ARB and what not, but most of these
19 vehicles are down in Los Angeles. We are about 80 drivers,
20 and we are talking family drivers, we are not talking fleet
21 drivers, we have business opportunities with Disney and
22 those sorts of things, but this is really key to everyday
23 people that have been in it. We have estimated pretty
24 successfully about 10,000 people have driven the vehicle.
25 And frankly speaking, I do not know if I have heard a

1 negative comment of those 10,000 people. We certainly have
2 some sort of people who swayed to a different technology,
3 that is understood, but overall, people who get in this car
4 are pretty amazed, including me, who continues to drive it
5 every day and am still thrilled with it.

6 Another part of our program, which I will talk a
7 little bit more, but 13,000 fills -- a lot of people talked
8 about how the infrastructure is sort of coming along, it is,
9 really in that year and a half timeframe, 30,000 kilograms
10 is not insignificant. Obviously the gasoline saved there is
11 something we are pretty proud of. Two winners -- in New
12 York, I continue to see people scraping their windows of
13 their fuel cell vehicles, another cool thing, these things
14 probably were not thought of years ago, we have vehicles
15 sort of 25,000 miles plus on them continue to generate
16 amazingly so, any engineer in this room will tell you, the
17 cars that drive the most are your best cars. So those ones
18 that have 25,000 miles on, we are pretty most impressed
19 with, we see the longevity of those cars continuing. And
20 recently, everybody has heard, we have announced a million
21 miles on the program in roughly those 18 months.

22 The other half of our program has been and
23 continues to be -- I cannot sit up here and tell you GM is
24 not committed to the fuel cell technology without telling
25 you, yes, we have spent \$12 million on infrastructure for

1 our program. It means something to us. People know about
2 these stations. We went out there partly to support our
3 program, partly to support the industry, and partly for our
4 leadership to learn. We understand an infrastructure
5 probably about as good as anybody out there at this point.
6 We own, lease, install, operate and maintain all the way
7 around on these. It is actually not the last year, it is 13
8 months now, we actually did first fills on another eight
9 fueling systems in this country, three of those are sitting
10 in Los Angeles, and at least two of those will be opened up
11 to our competitors. We know all of the equipment providers,
12 we continue to understand their technologies, we help them,
13 we work with them, they work with us. It is an open
14 dialogue at the end of the day. We are all over the world,
15 people understand that. And really, when it comes down to
16 it, why are we doing this? There is a lot of learning.
17 Project Driveway is about learning, and obviously the
18 technology development is a huge piece of it, and likewise
19 the project management, you know, a lot of people come up to
20 me and say, "What do we need? What do we need?" DOE asked
21 me several weeks ago. And I will tell you straight up, we
22 need Project Managers. We need to take this out of the
23 sandbox and start making it happen. The technology is
24 there. We are on the right path. We are certainly heading
25 in the right direction on every level, now we have to sort

1 of -- let's go execute a market. We have a lot of data,
2 continue to have a lot of data. We have systems with over
3 5,000 kilograms on them. In fact, one of those systems was
4 the cheapest ones we installed. And one of the problems
5 with not only myself, but the company, is the handshake to
6 first fill at LAX, that clean energy station sort of showed
7 an example of, you know what, we do not need a year and a
8 half to install these stations, it could take five months.
9 You know, a year and a half is a waste of everybody's time.
10 That is why prices start -- you know, costs start driving
11 higher, and those sort of things. So another one of those
12 proud moments for us.

13 So next step, obviously we have 115 vehicles on
14 the road, we will continue to have those vehicles on the
15 road, give or take some, depending on situations. I think
16 you have heard it from others, and I will reiterate it, the
17 fact of the matter is, we are not going to go play in the
18 sandbox anymore, GM is not going to probably sit around and
19 do another 100 - 200 car fleet. Really, at the end of the
20 day, I think we believe we have learned a lot of what we are
21 going to learn, not to say we are not going to continue to
22 learn, but, really, we are going to take the existing fleet,
23 we will put in -- you will see some slides here -- "some
24 technology insertions," meaning we will basically beef up
25 the robustness of that fleet, and what we are doing right

1 now, it is really putting our hands around what does a
2 reasonable automotive volume look like, how are we going to
3 go do that? And I am sure most everybody here will agree,
4 that is where we need to go. You can only play so much, if
5 you will.

6 Here is the timeline. This timeline is something
7 we believe in, we are shooting for 2015, sort of for these
8 reasonable volumes. There are no numbers on that, and there
9 is a reason why there is not, it is because of that bottom
10 line. There is obviously some risk associated with the
11 current environment, which includes, let's take today's
12 vote, if you will, government policy, the ongoing
13 infrastructure initiatives, we have to get there, to be
14 honest. You know, GM cannot go and spend a lot of money on
15 infrastructure again to be able to support a fleet. We need
16 this to be sort of everybody involved in it. And also, I
17 think it is fair to say these early vehicles are going to be
18 somewhat more expensive and we need some sort of incentive
19 to drive the market.

20 Some of you may have heard, we announced our fifth
21 generation stack, and I have actually seen it in the lab
22 working. Right now, it is sort of sitting up there, it is
23 what you guys saw in the press release. Right now, the
24 Project Driveway vehicles are sort of early development
25 vehicles. The program life is, "Hey, go execute," really a

1 full program, it was not, "Go execute a stack," if you
2 will, it certainly is a big piece of it. Right now, as we
3 speak, we are doing those updates, those technology
4 insertions to really drive forward. You can see in this
5 slide our gut and these are sort of volumetric, if you will,
6 we are going to double what we think our durability is on
7 the stack. We are certainly moving towards those places.
8 Our commercial stack, if you will, the fifth generation,
9 meets every expectation.

10 Likewise, you know, when you talk cost, you are
11 going to talk platinum, when you talk cost, you are going to
12 talk about simplicity of the system, our fifth generation
13 stacks are really driving out a lot of those costs. I think
14 we had 220 pounds lighter stack, it about fits in the size
15 of basically a 4-cylinder, it is roughly the half of the
16 size of the existing stack in the Equinox, so we are really
17 driving forward again to get to these things, so there are
18 steep learning curves here -- in the positive direction.

19 So, if you will, largely the left side of the
20 enablers is going to be economics driven. It is, I think,
21 why we are here today. If we had the perfect business case
22 out there right now, it would be being done, if you will.
23 So what we really need, really, to drive forward the program
24 is we need DOE funding involvement, certainly. We need
25 development investment incentives for the OEM suppliers. We

1 really want to continue along this path. Like I said, we
2 are not there, but we are heading in the right direction.
3 And then, likewise, how do we incentivize the market side of
4 things? The tax credits, the education, you know, carbon
5 taxes, all of these things have to be a part of this policy
6 moving forward.

7 The barriers, I think we all pretty much get it.
8 I am not going to sit here and beat it into you, but
9 certainly the cost is one side of thing, the infrastructure
10 is another side of the thing. And right now, it is sort of
11 the last bullet on the right side, as well as sort of the
12 summary there, is we need some certainty, right? We need to
13 understand how to drive this industry forward, and that sort
14 of starts with our leadership in the country saying, "Hey,
15 you know what? This makes sense, this is the path we are
16 going to take," and sort of everybody jumps on board, if you
17 will. And that certainly, in my opinion, would apply
18 likewise to California. We have led the industry, to begin
19 with, and we should continue to.

20 So where do we stand, sort of a little bit in
21 summary here, frankly, I believe we are among the leaders.
22 We have over 20 years of involvement in this, a lot of
23 dollars spent. We continue after two years to brag about
24 having the largest fleet. We basically believe we have the
25 strength in all of the technical areas that we need to

1 really drive this forward to the next step, these
2 reasonable automotive volumes. We estimate that the
3 industry, and this is probably underselling it, there has
4 been a lot of money spent, likewise. So you know, where do
5 we go? We really need to balance the high volume
6 introduction with the infrastructure, I think everybody has
7 said that, I will give you another answer on the next slide
8 to that point. We really need to focus everybody on sort of
9 these policies that are consistent and longer term, both at
10 the federal level and the state level. And certainly, the
11 economics of it really help drive getting over this network
12 effect. GM continues to aggressively pursue fuel cell
13 technology. We sit up here very proud of where we have
14 gone, and we are very proud of where we are going on this.
15 That being said, there is a lot of risk and certainly in
16 light of the current financial situation of this company, we
17 cannot afford to ignore that. That is the honest truth at
18 this point. We really need to basically get everybody
19 together again on the policy side, and push forward. So the
20 requests -- I have sort of said that, again, we really need
21 to focus on the existing infrastructure, make sure that is
22 good, build up some new stuff, we really need to keep sort
23 of the conversation going at the DOE level, I think we all
24 appreciate we were a little bit blindsided by what we
25 thought was going to be an open administration, so obviously

1 we need to continue to do outreach at every level, all the
2 time, and not rest on our laurels. And, frankly, one thing
3 that I think extends a little bit from the great work that
4 the partnership has done through the Action Plan is really
5 to revisit how do you do hydrogen in this state. I think it
6 would be a wise dollar spent, if you will, if we really sit
7 down and start to integrate a lot of what Gerhard said, a
8 lot of what Bill said, a lot of questions you have. This is
9 becoming a very very complex problem, given how many laws
10 there are in different places, the fact that renewables are
11 here, and really, to take the Action Plan, how do we go
12 execute the Action Plan? In some cases, I think there are
13 notations there to go do that, "Hey, let's go to these
14 communities and educate these people," and those sort of
15 things, but how do we get from the natural gas to the
16 renewables? How do we understand the requirements, the
17 risks, the outcomes in these key priority areas? Really, to
18 take a deep dive, in many ways these types of studies and
19 market tools have been executed for Ethanol, and biofuels,
20 they have been executed for other alternative technologies,
21 maybe it is time to actually right now to evaluate in the
22 next three to four years, before that, but we were going to
23 use in the next year or so, to really drive down how to go
24 make hydrogen happen. What does that mean in terms of
25 renewables? And, of course, I am not a person who offers up

1 a problem without a solution, GM is certainly willing to
2 help every aspect of such an effort. So that is the end, in
3 case you did not see, that is a real picture, what our
4 latest news release was, I believe last week, I think last
5 Thursday, as part of the DC -- it was announced from Charlie
6 Freese and whatnot. So I am done. Thank you. I go fast,
7 so I apologize.

8 MS. BAROODY: Thank you, Alex.

9 MR. WARD: Yes, I have a question, Alex. Thank
10 you for laying that out very well for us and we certainly
11 feel your passion on this, as well. We definitely want to
12 try and find a way through to make sure that we can meet, I
13 think, what is the most pressing, which is providing the
14 infrastructure to make sure that the trajectory for the
15 introduction of these vehicles is steady. Toward that end,
16 I think I am going to ask you, but I am not just going to
17 zone in on you, but I think we will be asking all of the
18 auto companies, is what is their take, and how would they
19 help us in making a business case for the retail
20 infrastructure for hydrogen. That is, using the resources
21 that we have available in the most capital efficient way, to
22 make sure that these are not wasted assets going down the
23 road. And I do not even want to infer that they would be,
24 but this is going to be a very strategic look at, as you
25 mentioned, your corporation has gone through some economic

1 turmoil, the State of California corporation has gone
2 through a little bit of economic turmoil, as well. So we
3 can see that we are going to have resource constraints. And
4 given that reality, and the fact that you and all the
5 automakers have worked well with the energy industry over
6 time to match up, and sometimes you are at odds, but to
7 match up the vehicles, and the fueling infrastructure
8 necessary to support those vehicles. I think we are going
9 to be leaning on you, as well, and you mentioned that you
10 would do anything in every aspect of this to help with this,
11 so I am probably going to take you up on that, but we would
12 like to get your best ideas on how we can actually transform
13 this from a government supported program to a retail and
14 thriving infrastructure for the time, and we have a few
15 years now before the roll-out of these larger numbers of
16 vehicles to come. So it is going to be a question of all
17 our automaker friends and also of the hydrogen producers,
18 suppliers, and those who will be a host for stations. This
19 is really, I think, where the rubber is going to meet the
20 road, so that we can make sure that our efforts here are
21 not just one, two, or three years, but are sustainable over
22 the long period of time, and have a trajectory necessary to
23 achieve success.

24 MR. KEROS: They will partly be vague, not on
25 purpose, but because I think the answers are, they are sort

1 of ambiguous to a certain degree to begin with, in my
2 opinion. First of all, I am going to pass the buck to the
3 energy guys, the equipment providers, because at least on
4 that side of things, personally, I see that there are some
5 technology improvements on the station side that we can
6 certainly take, meaning novel approaches, we are not making
7 hydrogen on-site, maybe we are doing it as a cluster city
8 where you do five stations, but only one of those stations
9 is producing the hydrogen, and we are shipping out to other
10 areas. So I think there are certainly novel approaches out
11 there that can be executed. That being said, my biggest
12 learning on the infrastructure side of things has really
13 been go do it. I will be honest, some people have heard me
14 -- I did not have the luxury of a timeline that went out
15 years. I got phone calls from my counterparts in Chevrolet,
16 who are executing a marketing program and all these things
17 we have said, literally at 6:30 in the morning, "Where the
18 hell are the stations?" And so, that type of market
19 pressure, if you will, really makes things different, it
20 changes your perspective, it sort of forces you to go
21 execute. I have heard in many cases, and hydrogen is not
22 the only one, it is all alternative technologies, "Oh, it
23 takes that long to do something. Why?" That is the
24 question we have to start asking ourselves. Why does it
25 take a year and a half to permit something? And if it does

1 take a year and a half to permit something in, let's say,
2 the City of Los Angeles, why aren't we doing something about
3 it? So, in many cases, the simplicity of the answer is go
4 do it. See where the weak points are, and then come back
5 and start to fill in those gaps. To date, we really do not
6 have a lot of good examples. Really, we have -- Gerhard
7 said there are four retail stations -- the honest truth in
8 that, there is probably one or two that, really, you could
9 say, "Yeah, those are retail stations." So we are sort of
10 the cusp of, "Okay, how do we go execute these?" And,
11 again, to a certain degree it is the project management side
12 of thing, to go and do. We really have to put some
13 aggressive timelines on these things to go make them happen,
14 and go make people -- we do not have the luxury of sitting
15 around and waiting. I think Gerhard's slide, if I saw
16 anything that really tells us that, if you are trying to get
17 to 2050, you have got to start now. You have to start now.
18 It is the power of -- so really, in one respect it is go do
19 and really put some aggressive timelines on these that, you
20 know, other industries put, you know, if not done by
21 December 1st, you are going to start paying us, those sort of
22 things, and I know that probably worries people, and I am
23 not suggesting it happen, but I am saying maybe those are
24 the type of situations that we have to start putting out
25 there. In the same vein, that means it calls -- I will say

1 -- the OEM's bluff, right? If you are going to put that
2 much pressure on people to go execute the infrastructure
3 side of things, the cars have to be there. Right? If you
4 put out 40 stations and they all look very good and we are
5 sort of sitting around going, "Where is the infrastructure?"
6 And it comes, really, now you put pressure back on, in my
7 opinion, the OEM's to go start putting out product. So it
8 is a little bit of a balancing show. Where I know there is
9 a lot of good work that has been done, but we really need to
10 balance the two carrots and sticks along the way, near term,
11 to go execute it. So, again, it is somewhat vague in the
12 respect of how do we do it, but I think we need to go do it.
13 We need more examples under our belts to say, "Hey, you know
14 what? Clean energy LAX took five months." And you know,
15 what, to be honest, it probably took too long. It took me a
16 month and a half to get the inspector to sign off on it, on
17 an air compressor. So, I mean, and that is -- obviously,
18 you see my perspective, it is a lot different than others
19 who, you know, we are waiting for stations to a certain
20 degree, so to me it is really knuckling down and making some
21 of this stuff happen quickly, in constrained timelines.

22 MR. OLSON: Alex, this is Tim Olson. I wonder if
23 you could, along the lines of your comments, elaborate on --
24 it sounds like you have 50 Equinoxes in California now, and
25 are you willing to show us where your customers are located

1 to help us in the siting of the stations?

2 MR. KEROS: The honest truth, and I have said it,
3 and I am not going to speak on behalf of my counterparts, we
4 go where the stations are. The first 10-15 stations, while
5 I want a specific location, let's call it Santa Monica,
6 let's call it Airline Torrance, the ones that we put out
7 there in the Action Plan, those are real locations. But if
8 there ends up being a station in Burbank, I am going to take
9 advantage of it. It will get flushed out. So our customers
10 have moved around with stations. Before our LAX station
11 opened up the South Bay for ourselves and we went and
12 basically tackled some customers there. As Culver City
13 opens up, it basically makes Santa Monica and Culver City a
14 little bit more attractive to go to. So I have said it, I
15 will repeat it, I really think the next 10 stations are not
16 difficult ones. I put in Culver City based on location. I
17 put in LAX based on location. I put in Burbank based on
18 location. People go there, they use them, they like them.
19 We know LAX is a destination point and we know it is a good
20 middle area. It does not show up on a California Fuel Cell
21 Partnership Action Plan, but the fact of the matter is, some
22 of those destination points need to happen in support of
23 these clusters. People get in these cars and want to go.
24 It takes them about 24 hours, they use up one tank in 24
25 hours every time, we hand them the keys, they use up for us

1 about 200 miles, and then they come to us and go, "Hey,
2 there is a station out in Palm Springs, can I go out there?"
3 It is so quick. The people get in this car and they -- the
4 great thing about a fuel cell technology, you prevent some
5 of the range anxiety, and people get it. They take
6 advantage of it.

7 MR. OLSON: Maybe I can ask this question another
8 way. So are you saying that the existing stations set up
9 satisfy your customer demand?

10 MR. KEROS: We have developed a program to do
11 that.

12 MR. OLSON: And that is to move the stations?

13 MR. KEROS: That is because, yeah, I mean, like I
14 said, we put Culver City in because that made sense to us,
15 Burbank, we have people going around Burbank. If we put
16 something in Encino, I can tell you, my leadership will say,
17 "Hey, let's go out to Encino and make something happen over
18 there." It is certainly early on, in my opinion, we do not
19 have to be so exacting. It makes a lot of sense, we have
20 done a lot of coordination, and I certainly think there are
21 some early target areas in the Action Plan that are honest,
22 Torrance, Irvine, Irvine - Newport, same thing, Santa
23 Monica, all make sense. Burbank, to us, makes a lot of
24 sense, as well. They are our neighbors. So these early
25 stations, the good news is we do not need 200 stations to

1 make a good go of this. We really need probably 40-50.
2 And the funny thing is -- no, it is serendipitous -- but,
3 you know, our studies show 40-50 stations in LA, partnership
4 studies show 40-50 stations in LA, you give it a good go, it
5 really makes it happen.

6 MR. ELRICK: Can I comment on that, Tim? Because
7 I think that is a good question to ask all the OEM's, the
8 half dozen or so up here, and as Alex described, they are
9 all going to have their top preferences slightly different.
10 But what the action plan did was collectively put all their
11 input and thoughts together and said, "If we do this as a
12 group," and that was what it was all about, "...what locations
13 make the most sense?" So Alex points out Burbank which, in
14 our model, was one of the secondary up and coming
15 communities, because we recognized the importance there, but
16 the four in LA, also San Francisco and Sacramento, were
17 collectively where all of them said, "We can make it go in
18 these locations." So I think you should ask them, and
19 hopefully they will give you some details, but that is why
20 those four communities popped out in LA.

21 MR. OLSON: Yeah, I guess any information you are
22 willing to share with us, so, for example, if you are using
23 the mobile system moving around for your customers, how did
24 that work? If the station in Burbank -- is it used? Is it
25 not used? Do you have any customer complaints about it?

1 Those kind of things are of value to us.

2 MR. KEROS: Our mobile stations really were
3 designed to sort of be semi-permanent, to be honest, so when
4 we went and installed the equipment at LAX, Culver City,
5 even Burbank, really, when we call them "mobile," it is
6 probably not the air products with wheels attached to it,
7 they come more, you know, bring a flatbed truck and move
8 them. Again, we strategically located those because it made
9 sense along the 405 Corridor, that is what the industry made
10 sense, and likewise we wanted to open up target areas, the
11 LAX station sitting at 105, and the 105 and the 405, you can
12 go anywhere. So the answer to your question is, yeah, I
13 mean, we are certainly willing to share what we can in that
14 respect. Obviously, some of the work that I think UC Irvine
15 is looking at doing, and those sort of things, it really
16 starts to open up the customer perspective. But I can tell
17 you, the customer perspective is, "I want to get going."
18 You know, the second customer we had was -- the second day
19 he had the car, second customer, second day he had the car,
20 he was out rock climbing in Riverside.

21 MR. OLSON: Another comment on the -- so you have
22 your 50 Equinoxes, you are in your fifth generation, do you
23 anticipate any increase in that number in the timeframe we
24 are talking about that Bill presented in 2015? Are you
25 expanding that number in California?

1 MR. KEROS: No. Cars could move around, but
2 nothing significant. Ten to 15 cars here and there, but I
3 would not see an increase.

4 MR. OLSON: And, in essence, this is kind of a
5 refurbishment of the Equinoxes -- are you expecting a cost
6 reduction in that genre?

7 MR. KEROS: Absolutely, yeah. Cost reduction,
8 durability improvements, not at liberty to say, but
9 significant improvements in range and the fuel economy
10 associated with those.

11 MR. OLSON: Again, if you are more willing to talk
12 about details, we are very interested in that.

13 MR. KEROS: Understood.

14 MR. OLSON: Thank you.

15 MR. KEROS: Thanks.

16 MR. ELRICK: Thanks, Alex. Next up on the
17 schedule, Robert Bienenfeld from Honda, for the Honda
18 perspective.

19 MR. BIENENFIELD: Well, good morning, everybody.
20 And thanks for inviting Honda to present our hydrogen
21 program and infrastructure needs. I really appreciate this
22 opportunity. Here is one of our customers in the South Bay,
23 actually, in the Newport Beach Area, and we delivered in the
24 last few months. I think we are here because everyone
25 recognizes that hydrogen is a great choice, even with

1 whether it is fuel cell, electricity generated -- sorry,
2 fuel cell, hydrogen generated from electricity, or even with
3 methane steam reforming, it is quite efficient with zero,
4 tell by emissions. When we look at greenhouse gas emission
5 on a well to wheel basis, compared to a conventional mid-
6 size sedan, the clarity in California is -- there are two
7 numbers here, one is 68 percent reduction, the other is 74
8 percent reduction, and the 74 reduction represents SB 1505
9 conditions that one-third of the fuels generated with
10 renewables. So actually we are looking at a nearly 100 gram
11 per mile car in terms of CO₂ equivalent, which is tremendous
12 and even lower than some of the estimates for electric
13 vehicles.

14 Over the last seven years, we have been able to
15 effectively increase the power to volume ratio by a factor
16 of 4, and increase the power to weight by a factor of 5, and
17 the result is a very compact, efficient, and powerful fuel
18 cell stack. We are looking at the introduction step by
19 step, we are in the limited introduction to market phase,
20 with the period that we are in now, where we are looking at
21 improving durability and reliability, extending practical
22 range, and working on cost reduction, towards some mass
23 production stage in the near future.

24 As I said, our first customers have been delivered
25 already. We have got 10 customers so far, starting from

1 July of last year, so about a year. We have got a fuel
2 cell dealership network that is in place in Santa Monica,
3 Torrance, and Costa Mesa. They actually find the customers
4 and make all of the delivery arrangements, and are
5 responsible for the relationship with the customer. And we
6 have got some dedicated fuel cell production at our factory
7 in Japan.

8 So we think the fueling infrastructure, the
9 dealership network, all of these steps are important towards
10 realizing a fuel cell market. Everyone has talked about our
11 three target markets, which we concur on, in Santa Monica,
12 the South Bay, and the Costa Mesa - Irvine area. We have
13 actually taken our needs down to the street level, or cross
14 street, where we think we need infrastructure, and we are
15 trying to shift the paradigm from chasing infrastructure to
16 being more market driven. I mean, right now, we have tried
17 to find customers where there are stations, and we are
18 trying to move it the other way around so we can build some
19 momentum. Our idea for market driven infrastructure, I
20 think the industry has really coalesced around these ideas,
21 the cluster concept is to start with small communities,
22 identify the key streets, the highways, or between
23 communities and destinations like work centers, resorts, and
24 airports, and we need to develop clusters within those
25 communities. There has got to be redundancy and back-up

1 with primary about five minutes from the home, and back-up
2 less than 15 minutes. We think it is real important to have
3 a Marquis kind of station that is an image station, where we
4 can show people the potential, as well as the smaller back-
5 up community stations, they have all got to be retail
6 oriented for our consumers to find the refueling
7 infrastructure acceptable.

8 I think several people have mentioned that fuel
9 cells have been under attack. DOE had their funding cut,
10 and the auto industry has been facing financial trouble.
11 And even the CEC funding for hydrogen was under attack. We
12 think that the reason for that is there has been some
13 feeling that it is a zero sum gain and if hydrogen gets
14 money, then that is money not going towards some other
15 technology. But I think people are beginning to recognize,
16 as was shared by Gerhard, that in order to achieve our long
17 term goals for the state and certainly globally, we need all
18 the technologies that we can bring to the market, including
19 fuel cell. You cannot get there alone with just one
20 pathway. So I think, as a couple people have mentioned,
21 continuous long term support is crucial to the successful
22 deployment of fuel cell vehicles.

23 We have strong support for fuel cell, we have
24 gone, together with the industry, and met with Congress,
25 White House, the DOE, and that seems to be bearing fruit.

1 We think that funding is going to be restored. Our Clarity
2 Program is functioning well and surpassing expectations. We
3 have had to slow down some volumes to match infrastructure
4 deployment uncertainties, and certainly global economic
5 challenges and other challenges, as well. It is early in
6 the infrastructure building phase, there have been long
7 delays between contract award and station opening. Even
8 CEC's aggressive action to open stations could take another
9 year or two, and station openings often include ramp-up
10 issues, so that after the press conference, you are not
11 really open for routine business. There is a learning stage
12 in making sure that all the bugs have been shaken out.

13 And there is also an issue of the leadership and
14 commitment in the partnerships that are developing these
15 stations. We have had, in some cases, weak or uncertain
16 partners at the retail, distributor, or energy partner
17 level, and yet strong interest, of course, from equipment
18 providers who want to sell equipment, the public funders
19 like CEC or ARB that want to develop the stations, and
20 certainly the OEM's that have a compelling interest in
21 launching the stations. So we need to think about ways to
22 kind of equalize the interest of all the parties involved.

23 We understand from discussions with CEC about our
24 infrastructure needs that there is a challenge here,
25 everyone is afraid of building infrastructure that is not

1 used, and I think the OEM's are concerned about making
2 public commitments about volumes that may change as
3 technological issues arise, or other barriers come up. And
4 we have got a small proposal here, and that is, to reduce
5 the risk of stranded investments, and to increase certainty,
6 that what we could do is come up with a number, and my
7 proposal here is something like 25 customers per location,
8 to say, "Here is a market where we think we can bring 25
9 cars in a certain timeframe, let's say 18-24 months, from
10 station development." This would give the investors like
11 CEC an opportunity to focus on a location where they know
12 that vehicles are going to materialize. And you have got
13 the risk of stranded investment lowered, and the incentive
14 that you are providing goes to the infrastructure, not
15 directly to any OEM, or to any consumer. And, in fact, on a
16 per vehicle basis, you kind of start off with a high cost
17 per user, in this case, I am thinking 25 customers for many
18 a \$2 million station, is something like \$80,000 per
19 customer, but it declines over time as you backfill and find
20 other OEM's who are going to market in that area with their
21 own vehicles, so that more vehicles show up and the
22 effective cost per vehicle goes down. We think that that
23 might be a good compromise from asking every OEM to commit
24 to a specific volume for each year. This way, we could
25 focus just on the gaps and start to grow the infrastructure

1 in a kind of a very careful and intelligent way. It is not
2 practical for the OEM's to share with each other where we
3 plan to market the vehicles, but we think we can do that
4 through the Fuel Cell Partnership, and I think the document
5 that they have shown is a result of that kind of thinking.
6 So this is to just take the Fuel Cell Partnership document
7 and make it a little bit more granular, so that you could
8 have more confidence in your station funding efforts. And
9 that is it.

10 MR. ELRICK: Thank you. Questions for Robert?

11 MR. OLSON: Thank you, Robert, very good
12 presentation there. I would like to ask you, in your
13 interactions with DOE, and your kind of urging to try to get
14 them back into this, are you -- I guess the question is, are
15 you interested in government investment, whether it is U.S.
16 DOE, or the California Energy Commission, or CARB, in
17 vehicle prototype, or advancing the technology as an
18 investment, as incentive investment?

19 MR. BIENENFIELD: Could you rephrase the question?

20 MR. OLSON: I will give you kind of a frame of
21 reference. This may not be completely applicable, but we
22 have set aside a pretty significant chunk of money for
23 advancing technology in a couple of areas, hybrid electric
24 technology, non-petroleum platforms, in the medium
25 duty/heavy duty area, and in fact, hydrogen would be one of

1 those candidates for maybe a bus technology, and it is
2 really pushing the technology to the next level, and with
3 some of the medium and heavy duty, the costs may be in the
4 range of -- from our investment -- in the range of \$3
5 million per prototype demo. Is there a need for that in the
6 passenger vehicle area, in this case in hydrogen?

7 MR. BIENENFIELD: Yeah, I think it is a great
8 question, and what I would say is that, in the volumes that
9 we are doing now, which are I would say not as limited as
10 prototypes, but certainly a lot less than any mass
11 production volume, the costs have been borne by the OEM's, I
12 think without substantial incentives. I cannot speak for
13 the industry, but from our viewpoint, at this level, we do
14 not think we need incentives for the vehicles. The
15 challenge comes in I think the next step up in volume, so in
16 the kinds of volumes we are talking about, through 2014,
17 probably not. But when we get to a step up in trying to
18 cross the Valley of Death, I think we are going to have to
19 really think a little bit more creatively because the
20 challenges there can be enormous, even for large companies.
21 So I do not think we have come down firmly on that specific
22 issue, but I would say for the near term not such a big
23 problem.

24 MR. OLSON: I have another question about your
25 manufacturing. Do you make any of your components in

1 California?

2 MR. BIENENFIELD: Yeah, the tank is made here.

3 MR. OLSON: That is something I think we would
4 like to talk to you more about, just from the -- another
5 initiative we have is we are about to announce is this
6 manufacturing plant located in California, an incentive
7 program that would be targeted for components -- batteries,
8 whole vehicles, and we have got quite a few companies that
9 are interested in this. The point of it is, some part of
10 that is in California, that means more jobs here.

11 MR. BIENENFIELD: Absolutely, and we would
12 certainly like to have you be in touch with our supplier on
13 that.

14 MR. OLSON: I also wanted to thank you for your
15 frank discussions not only in the public meetings, but also
16 in our private meetings about where your company is going
17 and how we can make this work with our program here.

18 MR. BIENENFIELD: Sure.

19 MR. WARD: Robert, again, thank you for your
20 presentation. It was very clear and to the point. I did
21 have one question. You had a reference in one of your
22 slides that said 80 and 20, and I do not think you hit on
23 it, but I would like to know what that refers to.

24 MR. BIENENFIELD: Oh, I am sorry. That should be
25 80 and 50. It is a little too aggressive. Sorry. Thanks

1 for picking that up.

2 MR. WARD: And I will get to the question that I
3 posed to Alex, as well to you. How do we reach out and have
4 you folks from the auto companies help us in reaching out to
5 the energy side of this, to make sure that we can plan not
6 just for the future, you mentioned CEC as an investor, and
7 how do we get to the point where we can back out our
8 investments in this? I think it is politically
9 unsustainable, as we all can appreciate, this cannot go on
10 forever, so we would like to really enlist your support to
11 help us with the energy companies, the fuel providers, how
12 can we make this a business proposition going forward in a
13 balanced way? And you had one question, how to equalize the
14 interest of all parties, and I think that is the crux of the
15 issue. Apparently there is not the same interest on the
16 energy side as there is on the OEM side, and so that is
17 something we would like to get to. I do appreciate your
18 willingness to kind of slightly alter your needs as
19 infrastructure is rolling out, and I like the idea of
20 focusing your vehicles where the stations do exist now, it
21 is a practical reality and I think it is one that is really
22 helpful. So, I just wound up, and now here is the pitch --
23 and how do you think we would employ the good offices of the
24 energy suppliers, the energy companies, in general, the
25 retail oil companies, in making this a more balanced

1 proposition going forward, and understanding that the
2 public funding of these stations is not tenable or
3 sustainable for the long term?

4 MR. BIENENFIELD: Well, I do think that you are an
5 important investor in making this market happen in the near
6 term, and I would say that, you know, I heard you use the
7 language of "making a business case" when you talked to
8 Alex, and I think that, between now and 2015, 2018, I do not
9 think there is a business case, I think you are in the
10 investing phase, and you are enabling the future of a
11 business case, I just do not think it is here in the near
12 term. How to create greater interest on the part of some
13 energy companies, I think there are some policy ideas that
14 could be explored. I think what Gerhard showed earlier
15 about kind of the ways in which you may or may not get
16 credit for making an effort like this in your LCFS
17 requirement, for example, there is an opportunity where the
18 energy companies are under enormous pressure to comply with
19 LCFS, maybe there are some ways of generating incentives or
20 credits for participating early in these kinds of programs.
21 But I am not an expert on that, but it just strikes me as an
22 obvious place to start.

23 MR. WARD: Great. I am not denying that we have a
24 role now to help with this at all, I am just trying to look
25 out in the five year to 10 year horizon to see, you know, we

1 are going to have to get to that point someday, and the
2 sooner we think about it, the better off we will be, and you
3 mentioned also thinking and investing creatively. I think
4 that is really everybody putting their thinking hats on here
5 to see what are the best mixes of regulations and incentives
6 and continued -- and introducing private support for these
7 things because it is going to have to come in at some point,
8 and so I guess I am asking that you would be willing to
9 shoulder some of that effort with us in a cooperative way.

10 MR. BIENENFIELD: Sure, absolutely.

11 MR. WARD: You always have been, I fully expected
12 that answer was yes, and so I look forward to a continued
13 cooperation you have shown to us in the future, that is, I
14 think that is kind of the crux on where we need to get to,
15 whether it is in five years or 10 years from now, I think we
16 have to be able to back out of our investments and make sure
17 these things are viable, and so that everybody has a vested
18 interest. You folks have one now for regulation, perhaps
19 the energy companies will be having a vested interest
20 through other means, as well, in the future. We will leave
21 that open at this point.

22 MR. BIENENFIELD: Absolutely.

23 MR. ELRICK: Other questions for Robert?

24 MR. BIENENFIELD: Thank you very much.

25 MR. ELRICK: Next on the agenda from Toyota, Mr.

1 Justin Ward.

2 MR. WARD: Great, thanks. All right, good
3 morning, everyone. Thanks for giving Toyota this
4 opportunity to come here and share some information with
5 you. This is kind of -- I am going to give a summary of our
6 progress and our challenges in our fuel cell development
7 program over the past few years. I have a bunch of slides,
8 so I think I am going to be competing with Alex on talking
9 speed, but feel free to interrupt me at any time to slow me
10 down or try to get some more information on these slides.

11 First off, I am just going to start by comparing
12 electricity and hydrogen because we get asked that a lot,
13 how do we feel these technologies play together. One thing
14 we like to show, and it is a slide maybe everybody sees, is
15 the volumetric energy density comparison, you know, when you
16 look at energy density from a volumetric standpoint, for
17 lithium-ion batteries, you can see as they compare with
18 hydrogen, hydrogen does have a much higher volumetric energy
19 density, but both are far lower than conventional fuels like
20 gasoline and diesel, so there are challenges for these
21 alternative fuels to really be able to provide a suitable
22 alternative for the customers. We think have shown, I
23 think, through our latest vehicle that we can achieve the
24 quick charge, long cruising range, through our hydrogen
25 technologies, through our fuel cell vehicle, but that is

1 going to be a very hard target to reach for the current
2 generation of lithium-ion batteries, and even the next few
3 generations of lithium-ion batteries.

4 The next comparison is where to fuel cell vehicles
5 and batteries compare when it comes to range. And so, what
6 this chart shows is, if you look at battery mass or volume,
7 compared to range, that you need to -- that the battery mass
8 or volume, you need to have a certain range. We have our
9 RAV4 EV that uses a nickel-metal hydride pack on that solid
10 green line, you can see there that if you want to get a 300-
11 mile range, a practical 300-mile range, not a test cycle
12 range, but a real 300-mile range, it is going to be pretty
13 hard to achieve with a nickel-metal hydride pack that we use
14 in the RAV4. If we look at lithium-ion batteries today, and
15 we look at technologies for lithium-ion that are not out
16 yet, but may be out in the next few years, you can get to
17 that dotted line. Looking at that dotted line, you may be
18 able to touch on the 300-mile range, but your mass and your
19 volume is 2, 3, 4, times that of what we are able to do
20 today with our SCHV system, this includes both the fuel cell
21 and the hydrogen storage system.

22 So this is just kind of to give you a sense of
23 where those technologies are in comparison to each other.
24 Now, that usually leads people to think we are very negative
25 about EV's and I get hammered all the time on the blogs

1 about our position on EV's, but the reality is, we do think
2 that EV's are going to be part of the market, and they are
3 going to be in that short-range, small commuters. And the
4 people that cannot afford to have a second car, maybe they
5 are going to move more towards the plug-in that is using a
6 biofuel, but we do think a big part of the market is going
7 to be managed by the fuel cell vehicles, specifically the
8 large to mid-size passenger cars, as well as buses, that we
9 saw earlier today, and then we will hear about later this
10 afternoon. So we do think that fuel cells are going to be
11 kind of the key, one of key players for a future sustainable
12 transportation system.

13 This is a comparison of total efficiency. Here is
14 another one that gets me in a lot of fun. This one shows
15 the well to wheel efficiency, and you can see here that the
16 fuel cell vehicle has a pretty big advantage compared to
17 some of the other technologies. Of course, when you look at
18 some of these assumptions, you can see we have for hydrogen
19 production efficiency 67 percent, this is membrane
20 separation in combination with SMR. For natural gas, we
21 have 39 percent, and that has to do -- it seems low, but
22 when you consider combined cycle and transmission losses,
23 and local losses, it is not so off numbers, it is relatively
24 close. But you can see the big benefit from both of those
25 technologies come from the vehicle side of efficiency it is

1 enormous, it is very very high compared to even our Prius
2 that we sell today. So one of the takeaways from the slide
3 is do not look at it as picking a winner because, as I
4 showed before, we actually think that there is going to be
5 these technologies that live together to really fit a
6 sustainable transportation system, and really what this
7 slide shows is, although the fuel cell vehicle has a big
8 advantage here, the reality is it is going to be fuel cells,
9 electric vehicles, and hybrid technologies, maybe through
10 plug-in technologies that really do form the pathway for a
11 sustainable transportation system.

12 This is the evolution of our FCHV. We were the
13 first to lease these in Japan and the United States in
14 December of 2002. I think we might have beat Robert by
15 about an hour and a half. But pretty much we are really
16 happy about getting those vehicles out and, since then, we
17 have made lots and lots of changes similar to what Alex had
18 mentioned earlier today, you know, it is really an
19 evolutionary process with these vehicles, and what we have
20 experienced lately is very exciting for us, and hopefully
21 out in the industry they find excitement, as well. But our
22 current FCHV, the FCHV-adv, we wanted to add some more
23 letters to that, it stands for Advanced, that vehicle
24 currently has demonstrated cool start up capability to below
25 minus 30 and it has a range far exceeding 300 miles. So we

1 are really excited about those key criteria which were
2 unsolvable back in 2002. We now feel we have good solutions
3 for those.

4 There are two remaining technical challenges that
5 we have not been able to meet yet, but we feel we are
6 getting very close, that is our stacker ability and our cost
7 reduction. On this timeline, you can see that 2015 that has
8 been mentioned a few times, this particular 2015 slide came
9 from the SECJ Conference, I forget what that stands for, but
10 I think it is defined later, and basically we got the
11 automakers and energy and government together and we talked
12 about where technology was, the timeline for development of
13 these technologies, and we tried to find out when will all
14 these technologies intersect to when commercialization can
15 happen, and in Japan that number was 2015. When we looked
16 at the United States and we tried to have these similar type
17 discussions through the California Fuel Cell Partnership,
18 and that 2015 number still looks reasonable, but it is not
19 going to be across the entire U.S., it is going to be
20 impossible to try to get stations across the entire U.S.
21 But when we looked at cluster-based deployments, there is
22 some feasibility to do cluster-based deployments by the 2015
23 timeframe.

24 Here is specs for our latest fuel cell car, this
25 is a picture of the Japanese model, you can tell by the

1 steering wheel being on the wrong side in that little
2 mirror there. The key takeaway from this slide is that, if
3 you look at the LA four-drive cycle, our total range is
4 about 455 miles, and our fuel economy on that drive cycle is
5 about 72.4 miles per kilogram, or miles per gallon
6 equivalent. So we are pretty happy about that achievement.
7 Early last year, we actually were approached by the DOE,
8 they really wanted us to prove that the car could actually
9 do it, and that it was not just some kind of gimmick we were
10 trying to play with everybody, and so they asked us to do a
11 real world evaluation of our car. So it took us a long time
12 to figure out what route we would want to use, and get the
13 contracts and everything set up, but we ended up on this
14 route which includes about a 50 percent mix of freeway and
15 city drives, and the total length was about 330 miles and,
16 during this drive, we had representatives from NREL and SRNL
17 actually in the cars with the drivers to make sure we were
18 not gaming or hyper-miling, or doing any kind of weird
19 driving techniques. And following the flow of traffic along
20 this entire route, we were able to achieve a fuel economy of
21 68.3 miles per kg, which if you do the math comes out to a
22 range of about 431 miles. So very very impressive numbers.
23 I think everyone who was involved with this was very happy
24 with the results.

25 This imagine, maybe many of you have seen already,

1 this shows the minus 37 start-up that we had done with our
2 cold testing a few years ago. The picture in yellow is
3 actually kind of funny, that is actually below minus 37, it
4 is a little under minus 40, but that was actually a PR shot,
5 so we did not actually have the data to show, but the
6 reality is the car can perform, even in temperatures below
7 minus 40. And if you do not believe me, you can ask Jared
8 Farnsworth, he is our engineer in Sacramento. He is the one
9 that is lying in the snow to take this picture.

10 So cost reduction is one of the big things I think
11 that a lot of people talk about with fuel cell technologies,
12 so there are a lot of naysayers out there that we cannot get
13 the cost down. And this is a cost reduction curve that we
14 showed maybe as early as 2002, and from that point, we were
15 showing, okay, well, starting at that vehicle cost, we
16 really need to drop the cost by 1/100th. And we know that we
17 can drop the cost one-tenth through mass production just
18 normally, we know that we can experience that through mass
19 production. So, really, the key is how do we get that
20 initial one-tenth cost reduction down from these first
21 generation vehicles years ago? And there are a lot of
22 people out there that say we cannot do it, well, I can
23 report to you today that we can do it, we are doing it, and
24 in some cases, we are ahead of target on our cost reduction
25 curves. We think that, by the 2015 timeframe, we will be

1 able to meet all of our cost reduction targets, and be able
2 to get these vehicles out in a way that makes sense.

3 How are we going to do that? One way is through
4 simplification, through the fuel cell system, hydrogen
5 storage system, simplifying the stack, downsizing, down-
6 weighting, reducing the platinum amount. Alex at GM showed
7 the great image of their latest generation stuff, I think we
8 are all really working hard to get those kind of same
9 achievements. Materials, you know, making sure that the
10 materials we choose make sense and that they are a lower
11 cost. And then mass production technologies.

12 These are intended to be videos, but they are not
13 going to play, but I can show you guys afterwards if you are
14 really interested to see it, but what these videos are
15 showing is what we have done to improve manufacturing. The
16 web handling on the left-hand side, when it was originally
17 flowing, it transfers -- basically, it is a thin film
18 transfer system, it transfers then films about 50 meters per
19 minute, that is not good enough if you want to do real mass
20 production, so what we have done is we have improved that to
21 over 180 meters per minute. On the right-hand side on the
22 very top are fuel cell stacking machine, I guess you want to
23 call it, and basically in the past the stacks were actually
24 lined up by hand, there was some guy who literally stood
25 there and dropped them down. Now, we actually do this

1 through a machine, and the machine, of course, has much
2 better accuracy, much better reliability, and we know we
3 always get the same product. And then the last one is the
4 tank wrapping machine, and I wish this video worked because
5 that is one of my favorite ones. The machine that you see
6 here is the state-of-the-art machine that we had bought from
7 an external company outside of Toyota, it is the best
8 machine money could buy for tank wrapping. And it is a
9 great machine, good results, but our guys hated it from the
10 very get go, we hated it, it was so slow. It does not fit
11 any kind of mass production scheme, so we started trying to
12 work with the manufacturer to improve the design, but they
13 were not willing to work with us. So we decided to make our
14 own tank wrapping machine, and later I will show you, but
15 our own tank wrapping machine actually increased the speed
16 six times compared to this state-of-the-art machine, and not
17 only did we increase it six times, but our project
18 variability was way way decreased, so much improved compared
19 to the original product, and our consistency was much much
20 better. So we made huge huge progress in that, and we think
21 that we only hit kind of the very beginnings of the
22 improvements we can make on all of these technologies.

23 So how do we get to fuel cell mass market
24 introduction, which is what we are here to talk about? And
25 really, we need to make sure that we get some kind of

1 benefit for every stakeholder. The vehicles need to be
2 able to come out in a cost manner that makes some sense, the
3 energy providers need to get some kind of benefit, and most
4 importantly, the customers need to have some kind of benefit
5 without a proper balance of these key stakeholders, then
6 what are we doing? So I think that is the challenge in
7 moving forward.

8 There are many ways from an infrastructure
9 pathways point of view that you can have a direct impact on
10 that. But when we look at infrastructure, we want to make
11 sure that we are always considering it from the right
12 timing, right place, and right methods. We use that tag
13 line a lot, in a lot of our materials, and it is really key
14 not just for the vehicles, bringing the vehicles at the
15 right time, right place, and right method, but also hydrogen
16 infrastructure. Does it make sense if you have a small
17 cluster to put in a huge network, a large station, you know,
18 rip up the roads and put hundreds of miles of pipeline, if
19 you have four customers in this one location. Can they be
20 better suited with a mobile or some other application? And,
21 for example, you do not want the opposite, you do not want a
22 very small station with a whole bunch of customers, or you
23 end up in situations where you cannot provide fueling when
24 the customers need it.

25 This is breakdown of hydrogen cost, just as an

1 example. This is the hydrogen station that was built in
2 the Aichi Expo a few years ago, and this just kind of gives
3 people a sense of the difference in costs, when you look at
4 the average cost of a gas station, to build gas stations on
5 the order of about a million dollars. This is Japan, so
6 maybe the numbers are little bit different. But you can see
7 orders of magnitude do not change so much. And then you
8 look at the building of the hydrogen station, this
9 particular 35 mega station was \$2.9 million, so you can see
10 there is a big difference between these two technologies.
11 And we need to work to make sure we can reduce that hydrogen
12 station cost. And hopefully we are going to hear a lot
13 about that this afternoon through those presentations.

14 This is just a little bit of a snapshot of the
15 FCCJ and there is the definition -- Fuel Cell
16 Commercialization Conference of Japan. And this kind of
17 goes over how we feel the station and vehicles are going to
18 have to roll out to meet that 2015 bogey. Looking at this
19 kind of technology demonstration, kind of market
20 preparation, early commercialization, and then full
21 commercialization, you can see that the vehicle ramp is
22 going to be relatively smooth, but the station ramp is going
23 to be more of a step function, it is going to look more as a
24 step function. And according to this FCCJ Plan, you can see
25 in the 2010-2011 timeframe, there is a big increase in the

1 hydrogen stations, and that is really kind of preparing the
2 next phase of the market to get the customers more readily
3 to accept that technology. And then you see this additional
4 big ramp in the 2015 timeframe, again, and that is really
5 needed there to really kind of get that early commercial
6 market up and ready. So in this early stage, there is going
7 to be this kind of a period of, you know, with a station
8 construction, maybe it is sped up, or there is a larger need
9 for a station. But as we move in that commercial time, you
10 will see that they will kind of grow in unison with the
11 vehicle numbers. This may be easier just to see than it is
12 to explain.

13 So in summary, fuel cell vehicles really are more
14 suited for longer range and larger vehicle applications
15 compared to electric vehicles, although electric vehicles
16 are well-suited for short range commuter use. Toyota FCHV
17 technology has been moving forward every year, every day,
18 and now getting a range of well over 300 miles, and being
19 able to start well under minus 30, which are key criteria
20 that were not possible only a few years ago. Towards the
21 2015 target of large scale fuel cell vehicle introduction,
22 we are really maximizing our effort now to address cost and
23 durability improvements. We are pretty close on both of
24 those, but we still need some time to dot the last few I's
25 and cross the last few T's. And then, conditions for mass

1 market introduction, really, we need low cost, easy access
2 hydrogen supply network is a must, it is not a wish anymore,
3 it has to happen, or it is not going to happen. And then,
4 further technical development and study of profitable
5 business models for hydrogen supply networks, so maybe I am
6 hopefully beating Peter to this question, and then a variety
7 of governmental incentives are critical to form initial
8 markets being on the 2015-2020. When we look at that
9 further technical development and study profitable business
10 models, I think one of the challenges we have is, when we
11 look at how to do hydrogen infrastructure, we all look at it
12 from our little paradigm and our experience, and I think the
13 challenge that we are going to place out through the
14 partnership and through our other efforts is to really start
15 to look at it outside of our own little paradigms, and maybe
16 we look at -- or maybe that forces us, or allows us to take
17 an approach we could normally not do. And I think through
18 efforts like at the Action Plan at the California Fuel Cell
19 Partnership, we can realize a similar study and maybe come
20 up with some very good and novel ways to find a profitable
21 business model for hydrogen supply network. So that is the
22 summary. Hopefully I did not run too long. If you have any
23 questions, I look forward to them.

24 MR. ELRICK: I would like to start off with a
25 question that I have not heard addressed yet, but from the

1 vehicle side, when you are planning for vehicle
2 deployments, how does the station -- obviously you need the
3 stations there beforehand, or you cannot deploy the vehicles
4 because they have nowhere to fuel -- but when you are
5 planning on from your end how long in advance do you need to
6 see stations so that they do not disrupt those plans?

7 MR. WARD: Yesterday is fine. No, the reality is
8 we -- depending on the model, for example, when we are
9 looking at fuel cell vehicle development, or when we are
10 looking at even conventional power train development, the
11 cycles can be anywhere from three to five years in the
12 planning stages. So if you are trying to set up your early
13 market vehicle in the 2015 timeframe, that means next year
14 you basically have to do all the planning, the preparation,
15 and the materials prep so that you can start that production
16 process or the design process to be able to implement
17 production by 2015. So if I am looking at putting vehicles
18 out in the 2015 timeframe, I really need to start to know
19 where stations are going to be now, or at least within the
20 next few months, so that I can make sure to line up the
21 vehicle production with the station production. That is the
22 ideal condition.

23 MR. ELRICK: Thank you. Other questions?

24 MR. OLSON: Tim Olson from the Energy Commission
25 staff here. Could you elaborate on how many vehicles you

1 have in California now?

2 MR. WARD: Right now, I think we just deployed
3 some on Friday, so I think we are up to seven or eight right
4 now, and the number will continue to grow. And if the CEC
5 wants to have our detailed numbers, then I would love to
6 schedule a meeting to discuss our detailed deployment plan.

7 MR. OLSON: Yes, we would like that. I guess one
8 other question is, can you give us a frame of reference on
9 what you mean by mass production? At what level of mass
10 production do you have to be to get that one-tenth cost
11 reduction that you noted on your slide?

12 MR. WARD: Yeah. When we refer to mass
13 production, we are just looking at typical volumes of
14 vehicle production, so consider any kind of low volume
15 vehicle -- what would be a good example of a low volume
16 vehicle these days? Most of ours are pretty high volume.
17 But looking at the tens of thousands of vehicles, you can
18 get significant cost reductions.

19 MR. OLSON: And are you doing any of your
20 manufacturing in California? Any component parts or any
21 part of your vehicle?

22 MR. WARD: For our current FCHV-adv, no. All the
23 components and the products are developed in Japan. But our
24 testing and evaluation is done based out of our California
25 office for North America.

1 MR. OLSON: I think we would like to take you up
2 on the offer, hopefully if you are available within the next
3 two to three weeks for a meeting.

4 MR. WARD: Oh, absolutely, no problem. I can meet
5 with you this afternoon if you really want to.

6 MR. PETER WARD: Thank you for your presentation.
7 There was one development you mentioned, your long range
8 capability with the vehicle has been enhanced. That is a
9 definite achievement. And can you tell me what effect that
10 has on the required stations and locations of those stations
11 as we go through the development phase here from now and for
12 the next five years? Are you meeting some of the needs from
13 the station standpoint?

14 MR. WARD: Not so much because we are still --
15 from our idea, the cluster-based approach really does make
16 the most sense, and we still need to have the home station,
17 and so the customers will still fill there. What we are
18 seeing now, that the customers have such a longer range, is
19 that, like Alex had mentioned, they are far more interested
20 now in filling up in far away stations, and so as we look at
21 these different applications, we may see maybe a stronger
22 need to enhance Burbank, or some other areas, that maybe we
23 would not normally have been real strongly pushing. But
24 right now, the data shows that the customers are just very
25 very happy to be able to not have to fill up every day.

1 They are very happy to be able to drive all week and only
2 have to fill up once, or every two weeks, and that seems to
3 be a big big benefit right now.

4 MR. PETER WARD: The other point you mentioned,
5 and I heard it loud and clear, is the low cost, easy access
6 hydrogen supply.

7 MR. WARD: Yeah.

8 MR. PETER WARD: Can you relate what activities
9 Toyota is undertaking in that regard to help us all pull
10 together in that very important area?

11 MR. WARD: Yes, actually -- unfortunately, I
12 cannot give too many details of what we are doing right now,
13 but we have been working for the past couple years now to
14 try to understand ways to develop new models, to realize a
15 low cost solution, and we are now getting some confidence
16 that our approach may work here in the United States, and so
17 we are slowly now walking it through different stakeholders,
18 we are going to talk to the partnership very soon to try to
19 get a better understanding if it is going to work here or
20 not, kind of the gut check. And if we get some confidence
21 it is going to work, then we are going to be most likely
22 handing that off to the partnership to run with it.

23 MR. PETER WARD: I would certainly like to hear
24 more about that, maybe in that meeting we are going to have
25 in the next few weeks about the roll out of new vehicles,

1 that would be an appropriate time to do that if you were
2 willing to.

3 MR. WARD: Absolutely, we would be more than
4 willing to do that then.

5 MR. PETER WARD: Further, you mentioned that there
6 is going to be further technological development and the
7 study of profitable business model in anticipation of the
8 question I was perhaps going to pose. I am happy to hear
9 that, obviously, and I think we all understand the reasons
10 for that is political, and sustainability, private
11 investment continually, so I am happy to hear and, if there
12 are initiatives that you folks are pursuing in that regard,
13 I would like to hear about any studies that you have
14 commissioned. As we are doing our Investment Plan, that is
15 important information for us to fold in, if possible, even
16 in early results.

17 MR. WARD: Okay.

18 MR. PETER WARD: Another mention you made was in
19 the 2015 to 2020 timeframe, public investment will be
20 needed. Our understanding was that it was needed now.

21 MR. WARD: Oh, yeah, it is needed now, so -- but
22 it is going to continue to be needed into that early
23 commercialization timeframe. I think that when you look at
24 the FCCJ infrastructure preparation, there is almost a stair
25 step function, and that is really the key -- you have the

1 stair step function now, and then you have it again
2 happening in the 2015, and those are kind of the key timings
3 that need to happen if we really want to realize a 2015 kind
4 of early commercialization.

5 MR. PETER WARD: And not putting you on the spot,
6 but I am asking more from a Toyota standpoint, do you really
7 believe that public investment is sustainable for the next
8 10 years in this infrastructure development phase, as the
9 principal investor in infrastructure that could be retail
10 under certain vehicles?

11 MR. WARD: Yeah, well, I think that when we look
12 at the infrastructure, and we look at how do we pay for
13 infrastructure, everyone needs to play some part, whether it
14 is through public funding, or private funding, or some
15 combination which probably makes the most sense, of a
16 balanced funding approach, and there are stakeholders and
17 there are industry members that are going to be profitable
18 in that industry when it exists, and so for them it could be
19 viewed more as an investment opportunity. So there is going
20 to be some balancing and harmonization that needs to happen.
21 Considering that, we think there is a sustainable model that
22 will get us through the next 10 years.

23 MR. PETER WARD: Okay, but I am saying, in view of
24 the fact that you folks are developing much of your
25 technology on your own, without public investment, or at

1 least within the large public investment that is required
2 of fuel stations, and so it is getting back to my question,
3 how do we reverse this trend that we are in right now, that
4 public investment is essential for this, and when I heard
5 that it was also going to be essential for 2015 to 2020, I
6 have to tell you, that took me aback. I really think that
7 if we are still in this model, public investment, a
8 principal investor in this infrastructure, I think we are in
9 deep trouble in 2015.

10 MR. WARD: Yeah, so it has to ramp down in that
11 case, not as a principal funding source. We need to know
12 how to ramp down in that same phase. But I do not think the
13 private industry is going to be self sufficient by then.

14 MR. PETER WARD: Thank you.

15 MR. MUENCH: Just a small one. Would you mind
16 going back to that slide, the pie-shaped kind of cost
17 breakdown? Oh, sorry, Tobias Muench, with Energy Commission
18 staff.

19 MR. WARD: If I could figure out how to work the
20 thing.

21 MR. MUENCH: Yeah, that one, thanks. I would be
22 interested maybe if people present at the panel here, maybe
23 Gerhard or Alex, people with experience with hydrogen
24 fueling station funding and construction, if they have
25 similar numbers, if it matches their experience, and even

1 other people in the room or this afternoon if we could talk
2 about that kind of data, I think that would be important
3 data for us to know more about -- if anyone wants to comment
4 or respond.

5 MR. ACHTELIK: The number, yeah, the total cost
6 for the station that shows on the slide matches what we have
7 experienced, and what we have sort of thrown in California,
8 too, is renewable requirement throws in an additional cost.
9 But we have started to collect individual breakdowns on the
10 different components, and it does vary, but it looks in line
11 with what we have found so far.

12 MR. KEROS: This is Alex from GM. Our stations
13 have been cheaper. The focus has been on quick and fast
14 deployment in some of these areas, so, you know, I actually
15 like this chart, Justin. I have not seen it before, and it
16 got me thinking, so I certainly would like to put together
17 something like this for our own cost scenarios. I think
18 there are ways to improve on at least that scale, again,
19 depending on what you are trying to execute. You know, if
20 it is 1,000 kilogram a day station, or 100 kilogram a day
21 station.

22 MR. WARD: And I think that is one of the
23 takeaways, too, from this slide. I mean, remember, this is
24 2005. Aichi Expo was not in 2005. So it is a little bit on
25 the older side, this data. And we are talking about 96

1 vehicles a day fueling, so it is a relatively high capacity
2 station. But, you know, there has been lots and lots of
3 progress on the station side since 2005, and I think maybe
4 Ed Heydom or some of the others can comment on how accurate
5 this number is today considering technologies that are
6 available now.

7 MR. KEROS: And just to mention -- sorry to
8 interrupt, but we keep forgetting there is a positive
9 business model out there, it is sort of the guys in between
10 that are losing money on this deal, but a lot of these
11 suppliers are not necessarily losing money, so some of these
12 component providers are making a realistic profit across the
13 board, it is just we might not be seeing it sort of up front
14 for some of these station providers who are not even capable
15 of recovering some of their costs at this point.

16 MR. MUENCH: I think we would also be particularly
17 interested in which ones of these components provide the
18 greatest potential for cost savings. Maybe some of the
19 folks this afternoon could say some details of that.

20 MR. ELRICK: All right, thank you, Justin.

21 MR. WARD: Thank you.

22 MR. ELRICK: I look around and I see we have Lance
23 from Nissan on the schedule, but I do not believe he is here
24 today, so we can go to Todd Suckow from Hyundai/Kia.

25 MR. SUCKOW: Since I see our time is supposed to

1 expire for the morning session in one minute, what is the -
2 -

3 MS. BAROODY: Do not worry about it, we will go
4 past noon.

5 MR. SUCKOW: Okay, so I will try to be brief,
6 though. Okay, again, my name is Todd Suckow. I am with
7 Hyundai/Kia. I wanted to give you a quick overview of where
8 we have come. We are a fairly relatively new player in the
9 fuel cell arena, I will kind of give you where we are and
10 what our current activities are, and a little brief touch
11 into where our future commercialization plans are.

12 Since 2000, we have come a long ways from
13 initially partnering with an outside vendor for the fuel
14 cell to internally developing our own, and through
15 activities with the partnership, and including the DOE
16 program, which are currently ongoing, as well as the MKE,
17 the Ministry of Knowledge Economy Program in Korea, we have
18 brought forth several different vehicles of different --
19 basically an evolution of our fuel cell fleet from concept
20 all the way up to small batches of vehicles.

21 Just an idea of where past and current, starting
22 with UTC fuel cell, all the way to the current 2007 -- old
23 technology -- internal stack, using powers such as lithium
24 polymer, as well as super capacitors. More on the more
25 recent developments, we have gone from carbon bipolar plates

1 to the middle bipolar plates on some of our newer vehicles,
2 and also expanding the ranges from current 186 miles on our
3 current DOE vehicles, all the way up to over 400 miles on
4 our Kia Borrego. Buses have also been evolving, as well,
5 going forward within the MKE program, starting at 160
6 Kilowatts and moving all the way to 200 Kilowatts,
7 maintaining the same range while we are decreasing the
8 amount of hydrogen stored on board.

9 In terms of evolution, we started fuel cell
10 development back in '99 to approximately a year ago, and it
11 was not until around 2002 we actually put fuel cells in the
12 vehicles, and the technology has been evolving to a point
13 where, around 2012, we are going to be -- we project about
14 greater than about 2 kilowatt per liter in our fuel cell
15 stacks. So, again, this shows you the range in fuel cell
16 stacks, the development and power density. Talking about
17 driving range, we did not publicize this, but we did also a
18 range, more of an internal range, a range test for our
19 vehicles immediately following the Borrego introduction at
20 the LA auto show, and we were able to drive from San
21 Francisco down to LA without refueling, and had roughly
22 about 75 miles left in the tank. So that just shows you
23 where we have come in terms of vehicle range.

24 Safety verification -- we have done various tests
25 in terms of safety and verification from side impacts, rear

1 crash, from all different -- basically on different
2 vehicles, mostly the Hyundai's and the Kias, and different
3 pressures within the tanks themselves.

4 Cold start-up, I know some of the automakers have
5 mentioned cold start-up capabilities. Ours is currently
6 around minus 20 degrees C, and we have done that and
7 demonstrated that on our internal stacks. I believe this
8 was done -- I think this was done -- I forget if this was
9 done in Minnesota, or not. I think it was. Durability --
10 another key step in the evolution of the fuel cell vehicle
11 deployment. We had a couple of data points, as well as a
12 few reference points, in showing how our stack has been
13 evolving in terms of meeting the durability goals set forth
14 by DOE, and relative points back in 2006 and 2008 where we
15 stand. Cost targets, probably the biggest -- another big
16 factor, in terms of the bottom line, I just wanted to get a
17 point out, and these are not necessarily a linear
18 progression, these are certain scenarios based on timing and
19 volumes. So in terms of the Hyundai Kia, where we are at
20 currently is somewhere between 1,700 and 600 cost per
21 system, cost per kilowatt, and again, there is a lot of
22 change. Justin showed their automatic stacking and we are
23 currently kind of using the semi-automatic approach of
24 getting the bite going on fully automatic of course would
25 reduce our costs, and again, mass production of the balance

1 of plant material. I also want to point out again some of
2 the goals set forth by Japan, as well as the United States
3 in certain time frames, in 2010, 2015, and 2020. A little
4 background, again, we were involved in the DOE program
5 within the United States, here in the California, Northern
6 California, Southern California, as well as Michigan,
7 deploying 33 vehicles, partnering with others -- our
8 technology partner is Chevron and UTC. In addition to the
9 U.S. Program, we also are participating in the Korean
10 Government Program, which is very similar to the U.S. DOE
11 Program, in which we have deployed 30 vehicles, and buses,
12 as well. And the vehicles we have deployed, again, at
13 various different technology levels or advancements as shown
14 in one of my further slides, and one of the big things in
15 this program is that the government, as well as other
16 industry partners, are developing stations throughout Korea,
17 mostly in the Seoul area, mostly through natural gas
18 reformation, and there is even a project using biogas north
19 of Seoul. So some of these program associations are
20 currently built, and five more are going to be built by the
21 end of the program, knowing that there is going to be use
22 for those stations afterwards.

23 Product strategies, this just gives you kind of an
24 evolutionary high level view of where we are at in terms of
25 back in 2000, we are figuring out this technology, which is

1 actually worth it, before it was what is the advantage of
2 fuel cells, and once we got beyond that and verified the
3 feasibility, again, we started to road test in 2004, began
4 prototype development that I showed you earlier, and then
5 targeting 2012 for a small scale production.

6 The next generation vehicle, the small serial
7 production, will be based off our next generation Tucson,
8 Hyundai Tucson vehicle, which is going to be on the market
9 in the U.S., I believe, next year, 100 Kilowatt stack of
10 metal plates, lithium polymer battery, 60 percent system
11 efficiency and -20 cold start-up capability. Again, this is
12 where we are putting all of our efforts in developing this
13 generation, this vehicle for the small serial production.
14 By "production," I am referring to hundreds to low thousands
15 in terms of vehicle production.

16 In terms of vehicle production for the next
17 generation vehicle, we are targeting two markets, mostly
18 Korea and the United States, and Northern and Southern
19 California, as shown, or as described in the California Fuel
20 Cell Partnership Plan. So we are working on -- I am working
21 on locations, identifying locations for stations that would
22 be best for our customers. So I welcome a meeting later and
23 we can talk further on discussing with a little more detail
24 on locations.

25 Finally, just to give you kind of the

1 commercialization, kind of a simple five-step program,
2 starting with step 1 through 5, and identifying we are kind
3 of in the step 2, step 3 program right now, and then step 4
4 is small serial production of our fourth generation vehicle,
5 and then scaling up after that. So I wanted to be brief
6 because I know we are running short on time, so that is all
7 I had.

8 But addressing your questions, can I start right
9 now? In terms of getting these infrastructure, I guess,
10 into a profitable state, I think earlier on I know we were
11 having difficulties right now in just getting the ability to
12 sell hydrogen as a fuel on a per kilogram basis, I think
13 that is the big -- in the immediate timeframe, I think that
14 is -- Bill maybe can speak to this a little better, but I
15 think it scared away some of the people that are interested
16 in investing in hydrogen initially because they did not see
17 developing -- selling hydrogen on a per vehicle, or on a per
18 fill basis, is not hard to understand, I guess, from their
19 perspective. Other things that I could think of is Robert's
20 idea of kind of guaranteeing the number of vehicles at a
21 certain site, or being based there, or as a home base, or in
22 a location where the customers would work, I think is a very
23 valid idea. I think those are the two big things that I can
24 see in moving away from the government fully funding the
25 vehicles. Again, if you can guarantee a necessary demand

1 for a station, I think you can get a lot more investment
2 into the stations by the investors. So any other questions?

3 MR. ELRICK: Questions following up how he has
4 anticipated some of the first ones?

5 MR. OLSON: Todd, this is Tim Olson. I would like
6 to -- do you have any investment from the Korean government,
7 similar to what we are hoping DOE will do?

8 MR. SUCKOW: Yeah, the Korean government has
9 invested from the MKE Program in the past and it is my
10 understanding they will be investing more into the future.
11 I do not know the extent of it, but there will be federal
12 monies from the Korean side going forward.

13 MR. OLSON: Very good. We look forward to talking
14 to you in more detail.

15 MR. SUCKOW: Thank you.

16 MR. WARD: You initially started out with a
17 Ballard stack. Is that right?

18 MR. SUCKOW: We started off with UTC as our
19 technology partner.

20 MR. WARD: Oh, I see.

21 MR. SUCKOW: So they developed some of the initial
22 stacks, as well as the stacks in our current fleet of
23 demonstration vehicles.

24 MR. WARD: So they are your stack provider now?

25 MR. SUCKOW: Well, through the end of the year, so

1 the program ends at the end of the year, and we have
2 vehicles, and we have demonstrated vehicles here in
3 Sacramento and Southern California with our own proprietary
4 technology unit. So we have both right now, but we are
5 going to be ending the DOE program by the end of the year.

6 MR. WARD: Going on to your own stack, then, your
7 own developed stack?

8 MR. SUCKOW: Yeah, like I said, we will continue
9 to develop that.

10 MR. WARD: Okay, on one of your slides you
11 mentioned the roll out as thousands in the 2010 to 2012 time
12 frame, and then I think there was also mention of tens of
13 thousands in that same time frame. Did I get that wrong?

14 MR. SUCKOW: Let's see here. I think what I
15 mentioned was in the fourth generation vehicle will be -- we
16 are targeting hundreds to low thousands of vehicles
17 produced.

18 MR. WARD: But as I mentioned, I think it was on
19 one of your slides that --

20 MR. SUCKOW: Oh, these are scenarios, sorry.
21 These are to try to put the cost numbers in perspective, so
22 at numbers, for example, in the '10 to '12 timeframe, tens
23 of thousands of vehicles, the cost numbers will be down
24 around \$180.00 per Kilowatt per system.

25 MR. WARD: Okay, so those are separate and

1 distinct scenarios.

2 MR. SUCKOW: Yeah, these are different scenarios
3 in terms of how we view material costs over time and based
4 on volume.

5 MR. WARD: Okay, and just to be clear, hundreds to
6 low thousands introduction vehicles is in your estimation
7 going to occur when?

8 MR. SUCKOW: Well, I mean, probably in 2012 is
9 when we are targeting.

10 MR. WARD: So you have a minimum of 100 and a
11 maximum of a thousand?

12 MR. SUCKOW: Yeah, somewhere around.

13 MR. WARD: We can have these discussion later, I
14 will not make it uncomfortable here at all. And was there
15 private investment in the Korean stations?

16 MR. SUCKOW: Yes. Yeah, there is a lot of -- the
17 exact numbers, I cannot say. My understanding, what they
18 have told me is that there is 50-50 cost share of the
19 stations in Korea between MKE, as well as the industrial
20 gases and SPG Chemical, and all the other -- I do not know
21 if anyone else here can comment, but that is what I have
22 been told.

23 MR. WARD: Well, that is helpful information. I
24 would like to learn more about that and I think there is
25 something we can learn from that and apply here in

1 California, and I look forward to discussing that further
2 with you. Thank you, Todd. Well done. Toby?

3 MR. MUENCH: Maybe just a side note or a question.
4 Ten stations, 30 vehicles seems very -- what is the strategy
5 behind it? Is it like funding, it is maybe geographical
6 reasons?

7 MR. SUCKOW: Well, part of it is anticipation
8 after this interesting period, so five of these stations
9 will be built by July of next year, and the program ends
10 next year, so the plan is the deployment of additional
11 vehicles that would be utilizing those stations. Right now,
12 they are using five stations and by the end of the program,
13 they will be using -- well, after the program, they will be
14 using all 10.

15 MR. MUENCH: So it is anticipation of more
16 vehicles.

17 MR. SUCKOW: Uh huh.

18 MR. MUENCH: Thank you.

19 MR. WARD: Thank you. Are those -- at what
20 pressure and at what cost were those stations, if you have
21 that information? If you do not, we will get it later, but
22 certainly this is obviously an example that we would like to
23 follow-up on.

24 MR. SUCKOW: I think both pressures.

25 MR. WARD: Oh, they are both pressures, okay.

1 MR. SUCKOW: Yeah, like I said, there may be
2 other people that may be able to answer the question better.
3 My understanding is they are both pressure.

4 MR. WARD: Okay, and the costs of the stations?
5 Any idea?

6 MR. SUCKOW: I cannot give you -- I do not know
7 that, but I should be able to find out, though.

8 MR. WARD: Yeah, I would appreciate that. Thank
9 you.

10 MR. ELRICK: Great. Thank you, Todd. On the
11 schedule now, Rosario Barretta from Daimler. Another
12 energetic speaker to give more of a conclusion on our light
13 duty session.

14 MS. BAROODY: Yeah, I am sorry we are going into
15 our lunch time. If you will bear with us, we will go
16 through this one more presentation and then we will take a
17 break and resume at 1:00.

18 MR. BARRETTA: So, hello everybody. Thank you
19 very much again to receive the opportunity to speak about
20 our fuel cell activities. My name is Rosario Barretta. I
21 am responsible for the fuel cell activities and fuel cell
22 corporation here in California.

23 Let me start with the overall slide which was
24 shown probably also from one of the other car manufacturers.
25 This is a portfolio of different technologies to ensure

1 sustainability. You see on the left the optimization of
2 the conventional power trains, and in the middle you see the
3 further increasing of efficiency for those combustion
4 engines, and on the right side you see the emission-free
5 driving which will be only covered through battery vehicles
6 and fuel cells.

7 So let's see here on this chart where the fuel
8 cell and the battery electric vehicles are located, you see
9 on the bottom the best efficiency is if you would use a
10 battery electric vehicle with just fuel pipe, 100 percent
11 renewable electricity. The fuel cell is a little bit worse
12 in efficiency if you use your renewable electricity, but the
13 better benefit on refueling, the time fueling and also the
14 range of the vehicle. And you see on the combustion engine
15 down on the right side, so they are regarding CO₂ emission
16 and also regarding well to wheel energy consumption worse
17 than the one I described before.

18 So this is a map of our vehicle operation. We
19 started to have a worldwide vehicle operation in 2002, so we
20 deployed more than 60 passenger vehicles and more than 36
21 buses and also sprinters. We collected more than 2.5
22 million miles in the last few years, and important for us
23 was to deploy those cars in the market to gain and to make
24 or collect data, experience, and to let flow those
25 experiences in further development, which we will show the

1 results in the next generation. Also important was to put
2 these cars and these vehicles in operation to build up a
3 certain amount of hydrogen infrastructure together with
4 other partners from the industry.

5 So this is a picture which shows you that Daimler
6 started already in '94 to build the first fuel cell
7 vehicles, which was the Necar 1, and since then we built
8 more than 20 vehicles. And then, in 2002 we introduced the
9 first pre-production series of fuel cell vehicles which was
10 the A Class and we are still running today. You see on the
11 left on the bottom the investment we have done in the last
12 15 years. We spent more than \$1.6 billion to make that
13 possible, to build up those vehicles to bring forward the
14 technology, and we reached -- we had achievements in two
15 passenger cars, light duty vehicles and buses, we have shown
16 the three star capability and we have shown the technology
17 could be operated in various geographical climate areas. So
18 the improved performance, stack life time and reliability,
19 and we reduced the weight and production cost.

20 This picture shows our road map to the
21 commercialized use of vehicles. I mean, as I said before,
22 we started to work in fuel cell technology in 1992, and we
23 are convinced, if we come to commercialize, fuel cell
24 technology is the best solution compared to the two days
25 combustion engine vehicles in that respect. So the first

1 generation which we have shown with the F-cell was the
2 technology demonstration. And I need to say also that the
3 passenger car has the [inaudible] [69:46] and the other, the
4 sprinter and the buses followed those projects. So the
5 second generation which will come by 2010, so early next
6 year, the purpose of this generation is to gain customer
7 acceptance and to build up also additional fuel hydrogen
8 infrastructure. So the aim of the third generation will be
9 the cost reduction, number one, and with introduction of
10 generation 4, which will be around 2015, we will have the
11 market introduction with cost of production 2. In 2020, we
12 will introduce the generation number 5, which will be
13 basically the mass production, and in that time the hydrogen
14 infrastructure should be available.

15 So this is a very nice picture that shows our
16 commitment from Daimler what we are doing. If you see in
17 the bottom of these charts, the A class, which we are still
18 in operation, the B class, which will start to be in
19 operation in 2010, and also already the involvement and
20 development of the further generation, so that means that we
21 are already doing our work, our homework, in order to bring
22 in 2015 the first cars to the market. Important also is
23 that, if we include today how many engineers are working on
24 the A class and B class technology, we have more than 500
25 engineers which are daily working in this operation.

1 Also very nice chart here on the left, again, the
2 picture I have shown before, the \$1.6 billion we have spent
3 in the last 15 years, and on the right side you see the
4 chart which shows you basically the major cost driver for
5 the technology is the build-up of vehicles. That means, in
6 other words, to make further -- to move with the technology,
7 you need to collect data, but the question is, you know, how
8 many cars you need to bring in order to go forward. So to
9 build up a small fleet like we are doing with the B class,
10 it costs us around \$400 million, so to make more experience,
11 and to bring the next generation would be enough to go less,
12 or to build up less number of vehicles, and so this is our
13 -- if you want, this is our effort, to show that it is
14 interesting, it is very important to us that we can build
15 here hydrogen infrastructure. So we bring the cars and we
16 need the infrastructure there.

17 So you see here, this is the two locations where
18 we have our fuel cell activities, we are based in Southern
19 California, in Long Beach, we also have an office and a
20 workshop in Northern California, but we will receive also
21 with deployment of the next vehicle support from our
22 Mercedes dealerships in different locations. Important to
23 say here is also that the most of the vehicles we will
24 deploy will be in the south in California and the LA area,
25 and we fully support the California fuel cell partnership

1 cluster hydrogen station, which will be built in the four
2 cluster in LA.

3 So this is the B class which we will introduce by
4 the beginning of next year. You see, this is a vehicle
5 platform which we use in Europe to -- we sell it with the
6 normal combustion engine. What we did was just to replace
7 the combustion engine with the fuel cell, and we had no
8 disadvantage in -- the truck is fully available, and so you
9 can see four to five persons in the car, so it is a car
10 which you can compete with a normal car with combustion
11 engine. So the car has undergone also in the safety
12 measures which all the Mercedes have to undergo in their
13 development. It is a very safe and a very nice vehicle and
14 if you see on the technical data on the right side, it is a
15 vehicle which can compete in every respect with a B class
16 combustion engine.

17 Some numbers, how many cars we are going to bring
18 here in the next years. The idea -- well, the plan is we
19 are going to build 200 cars and we will place the 200 cars
20 worldwide, and let's say up to 50 percent of them will be
21 deployed here in California between 2010 and 2011.

22 So what are the demand differences between the A
23 class and the B class? So we reduced the size stack by 40
24 percent, increased the power 30 percent, and consumption is
25 16 percent lower, even though the car is heavier, and the

1 range is increased by 150 percent. So beside that, we
2 increased the stack lifetime from 1,000 to 2,000 hours, and
3 the range from 160 Kilometers to 400 Kilometers.

4 This is a picture of the packaging, what it looks
5 like in the B class, so most of the technology you see is
6 underneath in the so-called sandwich bottom, you find the
7 tanks in the area where it is very safe, the fuel cell
8 stack, and some other components is in front of the bottom,
9 and parts like a module -- what do you call that part -- the
10 coolant? The cooling module, we have it here, the cooling
11 module is in front of the vehicle. So in the real part
12 under, or between the rear axle, we place the lithium ion
13 battery.

14 So this is the system, what are the main
15 differences to the A class? We have still the screw
16 compression, we changed the humidifier which will make it
17 possible to operate the vehicle at the -25 C, we increased
18 the power, and the system is in total higher efficient and
19 less complex than the one before.

20 So this is the last slide, I think. So the
21 achievement of the B class, the first year produced the
22 vehicle with the zero emission fuel cell drive. This
23 vehicle will have the same quality assurance process
24 employed for other vehicles at Daimler, and this vehicle
25 will be without any restriction regarding passenger luggage

1 space. And the F cell offers high driving performance
2 standards as standard two liters gasoline engines. So that
3 is ready for the customer for everyday use. So I am pretty
4 sure the B class is a milestone on the road of
5 conceptualization of fuel cell vehicles. And the last
6 comment from my side, if you help us to bring hydrogen
7 stations in this area, we will bring the fuel cell vehicles.
8 Thank you very much.

9 MR. ELRICK: Thank you, Rosario. Questions?

10 MR. WARD: Rosario, thank you very much for your
11 presentation. Well laid out and, as you mentioned, you
12 folks are very committed to the tune of \$1.6 billion over
13 time. That is quite commendable. I think that the
14 development that you folks have shown is truly remarkable
15 and you are a leader trying to bring this technology not
16 just to Germany and the rest of the world, but to
17 California, as well. And the roll-out of your vehicles is a
18 considerable number, and it seems to be a fairly large
19 number from what we have seen, 200 cars rolled out in the
20 2010-2011 timeframe, half of which are coming to California
21 -- up to half, you said?

22 MR. BARRETTA: Yeah, exactly. This is, I mean,
23 the last two or three weeks was the International Car
24 Exhibition in Germany, in Frankfurt, and so upper
25 management, they committed to these numbers -- 200 vehicles

1 will be the total number of vehicles for the B class and up
2 to 100 vehicles will be deployed here in California. And if
3 I say up to 200 vehicles, it means we make it also -- it
4 depends on the infrastructure. If we do not have sufficient
5 infrastructure, we are probably going to reduce the number
6 of vehicles, but the idea is to bring it up to 100 vehicles
7 here.

8 MR. WARD: In Germany, how many stations are you
9 planning on constructing to support 100 vehicles that you
10 would have there, or up to, or possibly over 100 vehicles
11 there?

12 MR. BARRETTA: That is a good question. I will
13 try to answer as good as possible, but I understood the next
14 one and a half years they are going to place around 15
15 hydrogen stations and, as you heard from weeks ago, there
16 was an MOU among Daimler and Linde, Shell, some other energy
17 providers in Germany, where they are trying to put together
18 a consortium to build up an infrastructure, so the first
19 task will be to build up the 15 stations, and then to go on
20 from there.

21 MR. WARD: Is Germany putting up funding for this,
22 as well?

23 MR. BARRETTA: Yes.

24 MR. WARD: Do you have a ratio of that? I know
25 you have many privates mentioned there, and I am honing in

1 on this because this is the type of model that we are
2 trying to replicate here in the United States, specifically
3 here in California, and I think the money is well placed if
4 it is seed money for private investment.

5 MR. BARRETTA: Yes, there is money, they are
6 providing money to build up the infrastructure. If I am not
7 wrong, it is 50 percent, but I can check that again for the
8 hydrogen station, and I think -- I am pretty sure they are
9 also providing funding for the vehicle, to build up the
10 vehicles.

11 MR. WARD: Are these going to be 700 bar or --

12 MR. BARRETTA: The station?

13 MR. WARD: Uh huh.

14 MR. BARRETTA: Yeah, I am pretty sure there will
15 be 700 and 350 bar.

16 MR. WARD: Okay, do you have any approximate costs
17 of those stations? I know it is projected right now, any
18 idea?

19 MR. BARRETTA: No, I mean, regarding this, I think
20 our partners from Linde, they can give you a much better
21 outlook on the situation regarding costs. I do not know. I
22 mean, I can say something in the number, I saw before,
23 around the \$2 million per station, this is what I heard, but
24 I do not have exactly number.

25 MR. WARD: Are your stations looking at the retail

1 environment, station?

2 MR. BARRETTA: Definitely. We are behind the
3 proposal from the California partnership and the number of
4 vehicles which I said today, that covers our part, which you
5 can see in the survey.

6 MR. WARD: Thank you again for your presentation.
7 I did take note of the agreement that you folks signed a
8 couple weeks ago. When we meet with you one on one, I would
9 like to learn more about that because the wording I was not
10 quite sure, a lot of the details of that, maybe you can fill
11 us in on that at a future time.

12 MR. BARRETTA: Definitely.

13 MR. WARD: I appreciate your presentation. Thank
14 you.

15 MS. BAROODY: Thank you. Well, before we go to
16 lunch, we have one WebEx question and I believe it is for
17 John Mough. So thank you very much for your speech.

18 MR. BARRETTA: Thank you.

19 MS. BAROODY: Okay, Pilar, if you would unmute the
20 WebEx. Go ahead, please identify yourself. Is she still
21 there?

22 MR. SMITH: I believe it is Nico Bowkamp. I might
23 be mispronouncing that. I believe I wrote it down. The
24 question to John Mough was, "Where will you do your hydrogen
25 station testing based on the budget you have developed for

1 hydrogen quality and dispenser testing?"

2 MR. MOUGH: Our station testing and the quality
3 testing will both be done out of our headquarters office
4 here in Sacramento. We also have a facility in Southern
5 California in Anaheim, but it is currently, it is a
6 laboratory facility and office space, and we do not have the
7 space to do any station testing there. So everything will
8 come up to our Sacramento office.

9 MR. SMITH: Thank you. I think that will answer
10 his question.

11 MS. BAROODY: Thank you. I just want to thank the
12 light duty panel for your participation this morning, and
13 sorry we had to go over lunch. So we have about 35 minutes
14 for lunch. And we have heavy duty at 1:00.

15 [Off the record at 12:29 p.m.]

16 [Back on the record at 1:10 p.m.]

17 MS. BAROODY: We want to get going with our Heavy
18 Duty Vehicle and Off-Road Applications Panel. I would like
19 to welcome Dr. Arnold Miller with the Vehicles Projects.

20 DR. MILLER: Thank you, Madam Chairwoman. Thank
21 you for the invitation and the opportunity to speak with you
22 today. What I would like to do is describe a project which
23 develops an application of fuel cell, hydrogen fuel cell
24 vehicles, which has a number of benefits as an early,
25 really, entry into such a market, over automobiles, which

1 you have heard about this morning. Cars have to be very
2 fast, beautiful, spacious, and cheap, finally, whereas
3 industrial vehicles, especially locomotives, do not have so
4 many constraints. They mainly have to make money for the
5 company that operates them. So this is the locomotive that
6 we have built, it is a switch locomotive, and it will be
7 arriving in Los Angeles next week to begin its demonstration
8 in Commerce, the City of Commerce Rail Yard owned by BNSF
9 Railway. This shows a rear view of it. This is a public
10 private partnership. BNSF is the private partner, private
11 funding source, and my company, Vehicle Projects, is the
12 technology developer, and then we have the US Army, two
13 logos here, the Corps of Engineers and the Defense Logistics
14 Agency is the provider of the funding. As cost shared
15 project, BNSF has put approximately half of the cost into
16 this project. It started in May of 2006.

17 Now, why fuel cell rail, in general? Well, it
18 marries the best features of conventional locomotives, that
19 is (inaudible) electric over electric locomotives, and
20 diesel locomotives, but avoids their disadvantages. For
21 example, it has the emissions characteristics of an electric
22 locomotive, but it has a much lower infrastructure cost,
23 which is similar to a diesel, and moreover, for rail, the
24 infrastructure is linear, it is a long railway, so it is
25 much simpler than for road vehicles, which have a two-

1 dimensional infrastructure. Now, if the primary energy is
2 renewable or nuclear, and it uses electrolysis water to
3 produce hydrogen, then you have no carbon in the energy
4 cycle, there is no CO₂ emissions or any other kind of
5 emissions in the vehicle's operation. And it is
6 significantly more efficient than an electric locomotive.
7 The electric ones, contrary to what you might think, are the
8 least efficient because you have to look at where you get
9 the electricity for them, and normally it is a co-fired
10 power plant, and so it is a heat engine, ultimately. The
11 diesels are a little more efficient than electric
12 locomotives and the fuel cell will be more efficient,
13 perhaps 10 percent, it is not going to be dramatic. That is
14 not the driving force, the driving force is lower emissions,
15 and you will see, lower fuel costs right now, or in the
16 future, as well. There are issues and I will discuss these
17 more. I will try to answer the questions of the Commission.
18 There is relatively high cost of fuel cells and, of course,
19 that is an issue for all fuel cell vehicles. Now, as we
20 will see in a minute, the fuel cell stacks that we use in
21 this vehicle are the same as the Ballard P5 stack modules,
22 which are used in the cube buses, the first generation, we
23 have about 2 million, my kilometers of operating experience.
24 Then you have entrenched competing technologies in fuels,
25 this is not a small issue, it is sort of an unspoken issue,

1 but it exists, and then hydrogen storage; among technical
2 issues, that is the most significant. The fuel cell itself
3 is mature technology.

4 Now why hybrid for our rail vehicle? Not all rail
5 vehicles, and certainly not all vehicles in general are
6 necessarily good as hybrids. I have written a paper, it is
7 in the Journal of Power Sources on this -- 2006 -- on which
8 rail vehicles make sense as hybrid, and this really tells
9 the story here, this is the duty cycle, the red curve is
10 power, and it is power vs. time. And at narrow peaks, they
11 go up to about 1.2 Megawatts, and then you have long periods
12 of idle, being idle in the rail yard. And even though you
13 have those high peaks, the average is only 75 Kilowatts.
14 This is over a huge amount of data. And so this is ideal as
15 a hybrid, it can be easily recharging the battery either
16 during this troughs or the outright idle periods, and then
17 when you need to go over these high peaks, the battery can
18 assist with that, and it is a parallel hybrid where the fuel
19 cell and the battery are additive in power.

20 This project has two specific objectives, one is
21 to demonstrate reduced noise and air pollution in urban rail
22 applications, including sea ports, and that will be
23 demonstrated starting in early October through December in
24 Los Angeles, and then, because you have a benign power
25 source, the fuel cell power plant, it opens a new

1 application for large fuel cell vehicles, and this is the
2 military interest, it is what is called power to grid, where
3 it can provide back-up power to military base or civilian
4 disaster relief efforts.

5 This shows the vehicle over a year ago under
6 construction. This is the battery rack, and this part --
7 this whole area here is the fuel cell power plant, and it
8 replaces what was originally a diesel gen-set. This started
9 life as a commercially available diesel battery hybrid, some
10 of which are operating, or did operate, anyway, at Port of
11 Long Beach, as diesels. This, of course, has no diesel
12 engine whatsoever, and there is no emissions whatever.

13 These are some of the specs -- it is 240 Kilowatts
14 continuous net power for the fuel cell prime mover, 70
15 Kilograms of hydrogen at 350 bar, and the hydrogen is carbon
16 fiber composite tanks, standard tanks that are used on
17 buses. Now, we have money already from the Department of
18 Defense to upgrade this, to go to a more advanced battery,
19 and then we will have six times more hydrogen storage, more
20 tanks, and it will be 700 bar rather than 350 bar. Then the
21 traction battery allows transients substantially above 1
22 Megawatt, probably closer to 2 Megawatts, and then this
23 technology is a lot lighter in weight than the diesel. So
24 you have to add ballasts because locomotives have fixed
25 operating weight and so we had to add 9,000 kilos of extra

1 ballasts to bring it up to its operating weight of 130
2 metric tons, or 287,000 pounds. Here it shows an expanded
3 view of it. This right here is the power plant. And we
4 developed all this, some of these components, as I
5 mentioned, the stacks, we purchased, we developed -- and the
6 hydrogen tanks -- but otherwise we developed it and we
7 designed it, and we are involved in the fabrication. BNSF
8 Railway actually fabricated it, including the power plant,
9 did almost all of the fabrication.

10 Okay, now, this shows it under tests. Right now,
11 it is still at a DOT Proving Grounds in Pueblo, Colorado, it
12 is operated by TTCI. Now, we are going to see a video here
13 of impact tests. It works better to run this from the
14 Windows Media Player, and Pilar has promised that she would
15 do this. It is a fairly large file. You can run it, Pilar.
16 The vehicle is not actually running when you see it here, it
17 is pushed, and allowed to coast into that consist that I
18 showed on the preceding -- on the PowerPoint slide. It does
19 not seem to be -- oh, yeah, there it is. I wonder why it is
20 not showing up. Well, maybe we will not see this. For some
21 reason it does not want to display, but it is running
22 somehow. Do you have any idea, Pilar? Because we had it
23 operating earlier, running off my memory stick, yeah. Ah,
24 okay, back to where we were. So maybe do it last. We will
25 do that at the end.

1 So in any case, this is a consist of three rail
2 cars that are loaded, they weigh 700,000 pounds altogether,
3 and the last car is braked, as well, so we have taken up to
4 5 mph, the video is at 3.8, but -- and that is with the fuel
5 cell operating. And there has been no problem. You have
6 well over 10 G's of force chalk load, and there has never
7 been any problem. We have had no problem whatsoever with
8 this vehicle. So if we could proceed now with the
9 PowerPoint?

10 Okay, thank you. There was a lot said about
11 refueling stations, and this is the one we have, it is
12 temporarily set up here at the proving grounds, this will go
13 to the City of Commerce yard and if there is interest in
14 this, I will explain how it works, but you can see it is
15 fairly small, and it is inexpensive, it was only \$150,000
16 for that entire refueling station. If you wanted to buy
17 something for automobiles, it would be a few million dollars
18 because it has to be very pretty and customer friendly, and
19 so forth. Now, here is where it will be. Here is the
20 Commerce -- or sometimes called the Sheila Yard, of BNSF,
21 and the refueling station will be right there. This is
22 where BNSF tests their new locomotives. And then it will go
23 also to the -- down here it says "to Hobart." There is a
24 yard not too far away that will be connected to, and it will
25 operate both between the yards and in both yards.

1 One of our important contractors is Air Products,
2 and they are providing the hydrogen presently in Southern
3 Colorado, and will be providing it here in Los Angeles. As
4 many of you know, they have a pipeline, red line in this
5 drawing, it serves seven gasoline refineries in Los Angeles,
6 built actually to serve eight, and the eighth one will be
7 coming online fairly soon. But it transports 400,000 kilos
8 per day of hydrogen at 55 bar pressure. The hydrogen is
9 produced at Wilmington, which is a very large hydrogen plant
10 dedicated to hydrogen in Carson Hydrogen Plants. But it is
11 26 Kilometers long and 6-10 inches in diameter, varies along
12 the length. Here are the results. The locomotive is
13 complete and has approximately 30 hours of operating time on
14 it. The operating interface is identical to conventional
15 locomotives, it is silent in the cab, which is eerie if you
16 have ever been in a diesel, a vibrating diesel locomotive.
17 And outside of the vehicle, beside the power compartment, it
18 is sufficiently quiet that you can carry on an unstrained
19 conversation. We have videos of it operating before it was
20 painted, that is why I did not bring them, but people -- it
21 is operating and people are standing on the walkway outside
22 and carrying on a conversation, and the video camera and
23 recording system picked up their conversation. So the
24 locomotive will arrive in Los Angeles in early October, it
25 will stay here until the end of the year, approximately.

1 Then, this is a quite positive result among others that we
2 will demonstrate as we go along, but if you would take
3 hydrogen from the Los Angeles pipeline, the energy cost
4 would be lower today than diesel, that is, it would be
5 between \$1.50 and \$2.00 per diesel gallon equivalent, there
6 is almost a 1:1 or almost identical energy content to a
7 kilogram of hydrogen and a gallon of diesel fuel. So that
8 would be the cost of a kilogram of hydrogen. And what we
9 like to do is, after this is demonstrated, it may go to the
10 Port of Long Beach, that has not been determined yet, but
11 that has certainly been a possibility we have been
12 considering for some time, but also operation at one of the
13 refineries, and taking the hydrogen from the pipeline would
14 be a nice adjunct to the demonstration of the vehicular
15 technology. I think that is the end of it. Do you want to
16 try to run it? So she is going to -- ah, okay. Very good.

17 MR. OLSON: While you are trying to set that up --

18 DR. MILLER: Sure, I will be happy to answer your
19 questions now.

20 MR. OLSON: Yeah, a question on -- I did not see
21 the front part of your presentation. Where is this cost-
22 wise in terms of this is a prototype demonstration? Where
23 would this go next in terms of development?

24 DR. MILLER: Well, it is going to be upgraded, I
25 mentioned that. We have actually two years of Department of

1 Defense funding to do that, so that will be a couple more
2 years, but it would be close to commercialization. This is
3 an experimental prototype and you have to go through several
4 prototypes to get it to a manufacturing level, but then you
5 would have to go through a manufacturing prototype -- okay,
6 I do not know if we have sound or not, apparently not, but
7 this shows it running into the 700,000 pound consist to test
8 its ability to withstand impact. But if you could hear
9 this, you would hear the crash and you would hear the track
10 noise, but actually in this particular one the fuel cell is
11 not operating, so --

12 MS. MAGANA: Do you want to show it again?

13 DR. MILLER: Yeah, let's show it again. Can you
14 make the sound operate?

15 MS. MAGANA: No.

16 DR. MILLER: So it is quite rugged. One nice
17 thing about locomotives is there is a good psychology
18 associated with them, of power and strength and durability,
19 which we just demonstrated here. So some people still think
20 fuel cells are appropriate for golf carts or something like
21 that, but they actually can power locomotives quite nicely.
22 I think we have finished the PowerPoint. I would be happy
23 to answer any questions of the Commission or anyone else.

24 MR. OLSON: Yeah, so I have another question on
25 the -- and maybe this is really addressed to the Air

1 Products, but when you said that the price of hydrogen --
2 the cost of hydrogen fuel was lower than diesel, do you have
3 anymore details on that?

4 DR. MILLER: Well, the reason for that is the cost
5 of hydrogen closely tracks the cost of natural gas, because
6 that is what it is made from, and that is cheaper because it
7 is a domestic product, rather than imported fossil fuel.

8 MR. OLSON: And they are making hydrogen for the
9 refinery, so --

10 DR. MILLER: Yes, exactly. Oh, they make it on a
11 massive scale, as you saw, 400,000 kilos a day. Now, the
12 price of gasoline and diesel fuel are not so high right now,
13 on the order of \$2.00 a gallon or a little bit more than
14 that, but if it goes back up to \$4.00 or \$5.00 a gallon,
15 then obviously this is going to be extremely attractive,
16 just for the price of fuel. And we would like to ultimately
17 make it from renewable or nuclear power, so you would not
18 have any greenhouse gas emissions, even in greenhouse gas
19 emissions, there is clearly no such emissions from the
20 vehicle, but if you make hydrogen from natural gas, you do
21 have CO₂, but it is a lot better -- a lot more CO₂ than you
22 would have for a straight chain hydrocarbon.

23 MR. OLSON: So in your last bullet there, so is
24 the price in the range of \$2.00 a kilogram?

25 DR. MILLER: That is correct. It is less,

1 actually. It is between \$1.50 and \$2.00 a kilogram at the
2 refinery.

3 MR. OLSON: Maybe we will hear more from Air
4 Products on that idea.

5 DR. MILLER: Yeah, it would be good to do that.
6 And we work with them fairly closely and, also, we would be
7 pleased to have the California Energy Commission to be an
8 observer at this project, or your delegate, or whoever you
9 would like, and come and witness this, and --

10 MR. OLSON: This is now at the rail yard in City
11 of Commerce?

12 DR. MILLER: Well, it will be. It will take about
13 a week, perhaps, for it to be transported out here, but it
14 is going to be finished with its testing in Colorado this
15 week, and then BNSF will transport it out to LA. They do
16 not -- it is not going to be Express delivery, so it may
17 take several days to get out here.

18 MR. OLSON: So, I am just curious, we have had a
19 lot of discussions with Burlington, Santa Fe, Union Pacific,
20 it had not really appeared to be any strong interest in
21 anything but diesel, and they had said they tried a lot of
22 different options, and is there a serious interest as a
23 follow-up to this?

24 DR. MILLER: Oh, absolutely. Well, BNSF has put
25 about half the money into this, and there has been quite a

1 few millions of dollars since May of 2006, and they have
2 about a thousand switchers in their fleet, and I do not know
3 the exact number, but I would guess close to -- well,
4 probably about 400 of those, maybe it would be in California
5 because they operate only in Western USA and California has
6 the largest population, by far, of the states. Now, they
7 are interested in retrofitting those locomotives, and even
8 though there are not that many switch locomotives, they have
9 a disproportionate negative impact on the environment,
10 especially in the cities because they operate in urban
11 environments, in rail yards, and they are surrounded by
12 people's homes. And so they have about, in California,
13 about 5 percent of particulate emissions come from -- or 5
14 percent of total locomotive emissions come from switchers,
15 the rest of them are line haul locomotives. But the switch
16 locomotives are disproportionately harmful because they have
17 like this bubble of particulate matter over these rail
18 yards, and the CARB is quite aware of this, and they have
19 been very influential, actually, in making the world aware
20 of this, and been a leader. So to answer your question,
21 BNSF is interested, they are, by contract, they own all the
22 intellectual property for this, on this locomotive, and so
23 presuming that it works as well as it has so far, then they
24 would be, I believe, interested in trying to commercialize
25 it.

1 MR. OLSON: Okay, very good. Thank you.

2 MS. BARODY: Thank you so much for your
3 presentation. We appreciate it.

4 DR. MILLER: Thank you.

5 MS. BARODY: Okay, next we have Paul Scott with
6 ISE. If we can just try to keep the presentations to 12 to
7 15 minutes, I know it is difficult, but we have a lot to fit
8 in, still, today.

9 MR. SCOTT: Hopefully I will fly through some of
10 these, as a result. And I have got to go backwards here, I
11 think, to give you a preview of what we are going to talk
12 about.

13 This slide points out a number of the vehicles we
14 have done, it is pointing out here most of these are
15 hydrogen vehicles. And this is a gasoline hybrid, this is a
16 diesel truck, this is a natural gas, all the others, that is
17 our first vehicle, our second, our third, our fourth, and
18 our fifth generation hydrogen bus designs. So this just
19 gives you a little bit of what we do. Our focus is
20 exclusively on electric drive, heavy duty vehicles, 140
21 employees, we have got about 300 vehicles -- near 300
22 vehicles in revenue service every day with about 50 million
23 to 20 million miles, I do not think anyone is counting
24 anymore, but Long Beach Transit, for instance, this is one
25 of the customers, and that is illustrated below.

1 What we do is -- this has a little bit of a lag
2 to it, so I overshot here -- what we do is take components
3 from Siemens, Ford, or Cummins, for instance, for the
4 engine, battery fuel cell, for instance, we have also used
5 UTC fuel cells, and couple them within the case of the
6 rotating engines, electrical generator, inverters,
7 electronic components, and we build a lot of them, all the
8 ones in yellow background here are things we build ourselves
9 because we have not been able to find satisfactory outside -
10 - so we are an integrator of these machines.

11 And you will hear from BAE today, they are a key
12 competitor in this industry, Ellis is the other one, and
13 they hold the diesel space, we hold the gasoline space, and
14 the zero emission.

15 Just to give you a status report, we have got
16 about 250 of the gasoline hybrids delivered in revenue
17 service, we have got 50 of the 60-foot articulated buses
18 going into Las Vegas in the next few months. I mentioned
19 the hydrogen buses, I will mention battery electric, all of
20 these, with the exception of battery electric, are full
21 performance buses. Freeway speed, hill climb, the fuel cell
22 bus, for instance, going to Canada will do a 20 percent
23 grade. And I am going to talk about some of the harsh
24 realities. First of all, the diesel is an excellent way to
25 store energy. Ethanol is also good. When you include the

1 tank mass, CNG is about as good as ethanol, and hydrogen is
2 a factor of 3 behind, but it is still pretty good as
3 compared to a battery, you notice the battery is a factor of
4 10 behind in energy storage capabilities, so you can do
5 things with hydrogen in a ZEV vehicle that you cannot do
6 with battery -- a key point. And it involves some
7 complexity. Basically a fuel cell system, or a rotating
8 shaft engine, the various electronic components you need to
9 drive a motor energy storage, and the auxiliaries we drive
10 directly from the electrical system, so all of the
11 auxiliaries are electric.

12 That is strange. We lost about half the
13 presentation.

14 MS. BAROODY: Just take a minute to change that
15 laptop here. For those of you listening online, we are
16 having momentary technical difficulties. Hopefully, just a
17 few more minutes.

18 MR. SCOTT: This is a slide that you have seen
19 before from a number of different presentations, the NRDC
20 program, for instance. The point of this, this is the third
21 hard fact here, is that whether you go biofuel, whether you
22 go battery electric vehicle, you still need to have hydrogen
23 as part of the long range picture. Fourth key point here is
24 the heavy duty vehicle is used typically up to 100 hours a
25 week, using 12,000 gallons a year, it is equivalent of 40

1 cars, so putting money into heavy duty vehicles makes sense
2 in the sense of being cost-effective.

3 And the other interesting fact, sort of a hard
4 fact for us, there are now 12 firms competing in the fuel
5 cell bus space. You have Daimler, of course, is a key
6 European, you have companies in Korea, in Japan, China, you
7 have within the USA E-Bus, Proterra, ISE, and a combination
8 of Venhul (phonetic), UTC, and AC Transit, all competing.
9 And the final point here, there are -- here is the outlook
10 for greenhouse gas reduction, there are several points here,
11 one is that the hybrid drive allows you significant
12 advantage, secondly, that you get significant advantage by
13 going to lower carbon fuels such as CNG, battery and fuel
14 cell offer large efficiency gains, about a 50 percent
15 reduction in greenhouse gases, and the final point here is
16 that, with a wind generation system, you can make renewable
17 hydrogen, and that could be game changing, especially as
18 people catch on that this is truly a zero emission solution.
19 And it allows us to avoid importing hydrocarbons.

20 Here is a news item from just last week lifted
21 from a HyFLEET promo, "Is a clean future too expensive for
22 us," is the point. And the answer I have got in green down
23 below here, "It was not too expensive to spend \$10 billion a
24 year on corn ethanol as a subsidy." And there are subsets
25 of what one can do with lesser amounts indicated on here, as

1 well. I will talk a little bit about the technologies.
2 Here is the London Bus that we are doing, the artist's
3 conception on the lower left, a breakdown of the fuel cell
4 system here. As you see, there are a lot of parts involved.
5 It is quite accessible. It is in a sense a full solution to
6 the zero emission problem, and this is a relatively
7 inexpensive fuel cell system. These buses go out at under
8 \$2 million, well under \$2 million. The BC Transit bus is
9 150 Kilowatt fuel cell in the back here -- I am just rushing
10 through these. Here are the BC Transit units in production
11 a few months ago, no longer in production; we do not have
12 further orders for them. We also are doing an all electric
13 bus, in many ways this is much more difficult than a fuel
14 cell bus. There are challenges -- funding being a key. We
15 just do not have enough people contributing to do this.
16 Insulation, support of electric infrastructure is going to
17 be a continuing concern, but above all, the battery cost,
18 the mass, and the volume. The bus is limited to a range of
19 150 mile range, that is just the best we can possibly do
20 with a battery electric bus. The answer here is, you know,
21 the ultimate answer is renewable hydrogen, as illustrated in
22 this slide.

23 Getting on to the questions, and the fiduciary
24 matters, we make about -- we have the capability of making
25 about 300 vehicles a year. Cost reduction is extremely

1 important to us. There are significant cost reduction
2 strategies available with investment and, of course, public
3 monies have been virtually frozen, venture capital nearly so
4 in the last year. I am giving you some projections here for
5 the next few years, 2011 and 2015 in two separate columns
6 here. Gasoline hybrid is now about \$550,000. I am guessing
7 that is going to come down maybe 10 percent, and then
8 another 10 percent in another four years. Natural gas
9 hybrids will be about \$50,000 more. Hydrogen -- full
10 service hydrogen buses, BC Transit, should come down to
11 about a million dollars, as we get a number of buses in
12 production. European money is very important on this. And
13 then we have battery electrics here, and these are
14 speculations since there has not been too much activity in
15 that arena.

16 Federal monies, our only significant sources of AB
17 118 match funds, but our recent experience has been negative
18 in that respect. ISE invests modest amounts of equity funds
19 to the extent that we can get monies available to invest.
20 Our urgent needs? First of all, an assurance of a market
21 with money and interest, indeed, for improved vehicles.
22 Secondly, an assurance of a cost of carbon-based fuels. We
23 do not know enough to make a projection whether oil goes to
24 \$200 or \$30, nor does anyone else. So there has been the
25 cost of fixing the cost of fuel, by means of some government

1 program that is under discussion, I guess, is all we can
2 say on that. We need hydrogen fuel at competitive cost, and
3 by competitive cost, we do not need \$3 hydrogen, we need \$6
4 hydrogen, because we have a factor of 2 gain just in the
5 efficiency. Development funds for component development --
6 we urgently need to get automotive quality components at
7 competitive prices, and these are large components, they are
8 not going to be developed by the automotive industry. We
9 have to do it ourselves, or someone else. And there are
10 many open opportunities, including CNG, hybrids, things
11 other than hydrogen. And finally, availability of loan
12 funds. Powerful incentives? One is for ARB to maintain, as
13 originally conceived, the zero emission bus rule such that
14 there will be a market in the state for zero emission buses
15 in the next few years. Secondly, the possibility of DGS,
16 Department of General Services, purchasing alternative fuel
17 vehicles. Similar rules for incentives for university and
18 college purposes. I mentioned award preferences for firms
19 developing renewable gases, fuels, and we can discuss all
20 these in more detail if you want. And there are
21 opportunities for NZEV approaches, which generally have not
22 been of interest to anyone. Once people see a fuel cell,
23 they want a fuel cell, and that is understandable. Thank
24 you.

25 MS. BARODY: Thank you, Paul. Next up, we have

1 Rudy Tapia* [42:23] with Vision Motor, although, hold on,
2 do we still have Jeff Grant on the WebEx? Jeff was going to
3 maybe make some comments. Is that right, Paul?

4 MR. SCOTT: Jeff indicated he was open to answer
5 any questions on fuel cells.

6 MS. BAROODY: Okay, we will move on then.

7 MR. WEISDORN: Good afternoon, ladies and
8 gentlemen. My name is Lawrence Weisdorn, the Founder and
9 Chairman of Vision Industries. We are dedicated towards
10 providing a solution for the heavy duty class A trucks that
11 are operating in and around the Port of Los Angeles and Long
12 Beach. On the slide, on the right side -- or the left side
13 of the slide itself -- is our freightliner, that is a zero
14 emission hydrogen fuel cell/electric plug-in vehicle, it is
15 currently undergoing testing in the Port of Los Angeles. It
16 was assembled for us by the freightliner dealer out in
17 Whittier, California, which is about 10 miles east of
18 downtown. The truck on the right side of the screen is a
19 Kenworth T660 that we are currently assembling for another
20 client. And both these trucks, again, are zero emission.
21 What we will be talking about today basically are solutions,
22 the hydrogen vehicle solutions, fueling strategies, and
23 future applications.

24 What we realized early on is that the chicken and
25 the egg problem that everybody is well aware of is something

1 that had to be overcome, so we have come up with a solution
2 that is specific to the Port of Los Angeles, and as the
3 previous speaker mentioned, there is a hydrogen pipeline
4 that flows in the Ports of Los Angeles, up along the
5 Domingas* [44:28] Channel and 405 out to 180, and so using
6 that as a supply for our hydrogen, we can effectively fuel
7 up to 4,000 trucks per day off of that pipeline itself, so
8 the egg problem is already solved within the ports. So then
9 the chicken problem is the truck itself, and we have already
10 produced that. The situation for the fleets that we have
11 talked to is basically they are looking for a turnkey
12 operation, in other words, here is your truck, here is your
13 fueling solution, and ultimately to get wide adoption of the
14 hydrogen zero emission program, you have to be able to
15 operate at cheaper per mile than diesel. So with the
16 availability of the pipeline diesel in there, and then based
17 on early testing of the trucks, we are finding we are
18 getting approximately the same mileage from a pound of
19 hydrogen, as made available through a gallon of diesel, so
20 were are finding one pound equals one gallon of diesel in
21 the stop and go traffic that you experience on the Port,
22 which would not be true on open highway driving.

23 Again, the situation at the Port is very interest.
24 The trucks all come back to the Port numerous times per day,
25 so there is no point in trying to fuel them out at their

1 destinations. By simply putting in three fueling stations,
2 one by the 710 Freeway, one by the 110 Freeway, and the
3 other one by the 103 Connector, you can effectively fuel the
4 entire fleet of trucks from three large truck stop stations
5 right in the Port. The fleet operators are also very
6 interested in receiving long term supply contracts for their
7 hydrogen. So, in other words, you can get fixed pricing, it
8 stabilizes their cost per mile, and it allows them to become
9 extremely competitive when competing against diesel engines.
10 Ultimately, you want the hydrogen trucks replacing the
11 diesel trucks because there is zero emissions.

12 1806, the very first internal combustion engine
13 ran on hydrogen; 60 years later, they invented the internal
14 combustion engine that ran on gasoline; 1892, Rudolph Diesel
15 came up with his, and it has been diesel and gasoline ever
16 since then because essentially they are cheapest per mile.
17 So the key to getting wide adoption to this hydrogen program
18 is to make sure that it is cheaper per mile than the other
19 competing fuel, which is diesel. Technology and
20 manufacturing and the producing of hydrogen have come down
21 to the point where hydrogen can now be produced very cost-
22 effectively, and most importantly, the consumption of
23 hydrogen in the fuel cells, the fuel cell technology itself,
24 has been dropping rapidly, and we are now at a point where
25 an inflection has been reached, and so, with

1 commercialization, you can actually drive or travel cheaper
2 per mile on hydrogen than you can on diesel and gasoline,
3 and that is very important to make sure that the broad
4 market adopts the hydrogen. Hydrogen costs, again, with the
5 supply from the pipeline gas, we are looking at stabilizing
6 between \$1.50 and \$2.75 per pound. We like to discuss it in
7 pounds as opposed to Kilograms because we are finding a
8 pound gets you as far as a gallon of diesel, so it is very
9 easy to equate.

10 Why hydrogen? Everybody is pretty well aware of
11 all this stuff, it is cheaper per mile, zero greenhouse gas
12 emissions, our trucks are extremely quiet. When you go to
13 our website at VisionMotors.com, and view the truck, we
14 actually have to have them honking the horn every once in a
15 while so people understand that we have not cut the audio
16 feed. You will see cars going by, and the cars are noisier
17 than the truck. These things are truly, you know, the only
18 thing you hear is the tire noise. There is no idling,
19 substantial increase in torque, hydrogen fuel cells create
20 electricity, so you are running an electric motor. You have
21 got your torque available from zero, we actually have to
22 limit our torque, depending on which transmission is put
23 into the truck. Hydrogen is made right here. The hydrogen
24 we are looking at is right in the Port of Los Angeles, so it
25 is domestic, it is secure, there are technologies that are

1 coming up that, over the next one or two years, we believe
2 will make renewable zero emission hydrogen available at
3 competitive pricing. As you all know, hydrogen can be made
4 from a variety of sources, water, CNG, there is even
5 technology that converts municipal solid waste to hydrogen.

6 Numerous car companies that you heard from this
7 morning, they are all rolling out hydrogen. The beauty
8 about that is they are going to be in charge of educating
9 the public about the benefits of hydrogen, the safety of
10 hydrogen, and basically they will be spending millions of
11 dollars educating the public and we all receive the benefits
12 of that education.

13 State and federal support -- in the early stages,
14 obviously, it is very desperately needed to make sure that
15 we make this transition from basically demonstration
16 projects, or early demonstration projects into commercial
17 viability.

18 Very quickly, this is comparing the three clean
19 technologies operating on the Port. There is the 2007 clean
20 diesel emissions LNG trucks, and then our Vision Tyrano*
21 [50:23]. Horsepower, which is your ability to maintain
22 speed once it is attained, is more than enough. Torque,
23 which is what the truckers are interested in, is your get up
24 and go, this is your pulling ability, your ability to
25 accelerate. Again, we have got up to 3,200 foot pounds

1 available, which will shred most transmissions, so it is
2 limited to whatever the transmission can take.

3 Very important for the people looking at
4 infrastructure, the hydrogen truck will consume
5 approximately 10,000 pounds of hydrogen per year. And so
6 that is something -- it is equivalent to somewhere between
7 60 and 65 cars, and so putting one of these trucks on the
8 road, you will have to put in an equivalent amount of
9 infrastructure to support 65 cars, so by commercializing the
10 fleet and getting them deployed into the Port, you are going
11 to really speed up the adoption of infrastructure, the
12 production of fuel cell grade hydrogen, the ability to
13 distribute it, and everything else. So putting the money
14 into the trucks and getting them out there will really
15 really accelerate your infrastructure roll-out for all of
16 the cars.

17 As you can see, the particulates, everything else,
18 you know, it is zero emissions. But when you get down to
19 the CO₂ numbers, these are substantial numbers, you know, by
20 running a hydrogen truck versus a diesel truck, that is
21 about 100 tons of CO₂ reductions per year, and even compared
22 to CNG, which is a misnomer calling it "clean," it is just a
23 cleaner fuel. You know, the 70 ton reduction over the
24 CNG's. And, again, zero noise pollution, so the possibility
25 of operating in neighborhoods or off-hours when trucks are

1 currently not allowed to operate.

2 Okay, that one did not come in -- basically it
3 shows -- obviously as more trucks are priced, are sold, the
4 price comes down. Our initial prototype, the first one
5 through off the line was approximately \$950,000, we are down
6 to about \$400,000 per pop on the next three or four trucks,
7 and what we are looking at is a 20 truck demonstration
8 program that we have partnered with the Port of Los Angeles
9 and Swift Transportation, and we are looking at a cost of
10 approximately \$280,000 per truck on that demonstration
11 program, and it drops to around \$250,000 fairly quickly
12 after that, and we believe in about two to three years out
13 from now, we can be down to around \$160,000 per truck, which
14 by the time you have your cost savings from the cheaper
15 transportation fuel and also some of the federal tax
16 credits, it will actually be much cheaper for you to drive
17 with hydrogen than it will with diesel. Fuel cells, pretty
18 well everybody in the room knows how one works. And no
19 pictures attached.

20 But other projects we have got coming up are -- we
21 have been approached by several of the cities in Los Angeles
22 with the possibility of looking at our drive train in a
23 refuse truck. Obviously anything that is stop and go
24 traffic, where there is a lot of idling going on, absolutely
25 perfect application for the zero emission drive train.

1 Finally, ultimately these things have to be
2 bought by commercial interests, so what you are looking at
3 on the purchase side is currently there is a \$40,000 federal
4 tax credit for heavy duty alternative vehicles, and then we
5 are discussing with numerous departments as to what type of
6 state credits and regional subsidies and credits can be
7 established. Again, for early adoption on this, some of the
8 commercial truckers, they are willing to step up and take a
9 risk on a new technology, especially if it has got the
10 promise of operating cheaper per mile, but they are going to
11 have to have some significant subsidies to take the chance
12 on the initial purchases. So for the first couple hundred
13 trucks, we are looking for significant subsidies from the
14 government to get these guys to adopt it, fall in love with
15 the technology, and then allow it to become fully
16 commercialized. Again, when you are operating these
17 hydrogen trucks, we are looking at 35-40 percent discount
18 per mile over diesel, if you have got an increase in power
19 and performance over diesel, there is no exhaust, they are
20 very quiet operation, you have got re-gen braking, so in
21 other words, you are allowed to use your Jake Brake within
22 City limits now. What we are hearing back from Eaton, who
23 is running an electric hybrid situation on their trucks,
24 typically in the old days, the brake shoes would be replaced
25 several times per year, on the early trucks with the full

1 re-gen braking, they are in over two years now without
2 having to replace their brake shoes, so a dramatic drop in
3 the maintenance costs.

4 No oil changes. And probably most important, at
5 the end of the day, you are not coming home to your
6 sweethearts smelling of diesel. And with that, I would like
7 to thank you and hopefully I kept it down to 10 minutes.

8 MS. BARODY: Thank you, Lawrence.

9 MR. WEISDORN: Any questions?

10 MR. OLSON: Yeah, a couple questions here. So how
11 was your -- I did not catch -- how was your first project,
12 that prototype, that was all your investment from your
13 company?

14 MR. WEISDORN: Yeah, we are a private -- we have
15 been privately funded. We have put about \$3.5 million in to
16 date over the past three years, and now we are at the point
17 where we have proved out the prototypes to the point where
18 we have developed a production version, we have partnered up
19 with Freight Liner where we will drop ship the components to
20 Freight Liner, they will assemble it in Whittier, and then
21 the truck will be marketed and sold by Freight Liner as a
22 Freight Liner with a Vision drive train in it. And they
23 have also agreed to service it and do all the warranty work
24 on the program.

25 MR. OLSON: And refresh my memory of the Port of

1 LA Agreement. Aren't they about to put out a bid, or are
2 they in the midst of putting out a bid for this? Is that --

3 MR. WEISDORN: Yeah, correct. They are in the
4 midst of -- I think it is RFP or RFQ where they are looking
5 at adding us officially to the program to qualify for the
6 Clean Trucks Program down at the Port. One thing I would
7 like to mention also, Freight Liner, the present capacities
8 are that they can assemble 35 trucks a month for us,
9 starting immediately, and within a six-month period, they
10 could be up to approximately 100 trucks per month. So we
11 are in a situation that, if we received an order for 50
12 trucks tomorrow, the first of those orders would come off
13 the line 16 weeks from now, so this is a shovel ready
14 project, as they say at the Feds level, and it is ready for
15 roll-out.

16 MR. OLSON: And are you open to showing some of
17 the performance data, what you have come up with so far in
18 your prototype?

19 MR. WEISDORN: Absolutely. It is on my computer
20 on a different file, but we can share all that with you.

21 MR. OLSON: Okay, very good. Thanks.

22 MS. BARODY: Thank you very much.

23 MR. WEISDORN: Thank you.

24 MS. BARODY: Okay, we have about 25 minutes left
25 before our next panel, so I would like to welcome John

1 Maddox and Tom Apalenek with BAE Systems.

2 MR. MADDOX: Good day, everyone. Thank you for
3 having us here. If you are not familiar with BAE Systems,
4 we are based in London, England. It is a fairly large
5 company, about 105,000 employees, and we are in over 100
6 countries now, in 37 states, a large defense contractor and
7 annual sales are approximately \$33 billion.

8 This is to show you quickly our footprint
9 worldwide. A little less than 37,000 employees in the
10 country and, more importantly, 5,700 employees in the state
11 of California. One of the notable things about our company,
12 and we will tell you why you should know about hybrid
13 technology a little later in the presentation, but we have
14 in successful service today over 2,300 diesel hybrid
15 electric series products across North America, the largest
16 fleet being in New York City and, as you can see, several
17 other large cities, including London, and an order in
18 Seattle for 500 additional.

19 The largest single fleet in the world is in New
20 York City Transit. At the present date, there are 1,222
21 units in service, of which 241 of those have the new lithium
22 ion now phosphate technology battery system, 453 more to be
23 delivered.

24 The third largest hybrid fleet in the U.S. is in
25 the City of San Francisco, with Muni, 86 40-foot and 30-foot

1 units delivered there a couple of years ago, and there are
2 also 17 units in service in the City of London, and that is
3 an Alexander Dennis bus, which we have an exclusive
4 agreement with four dual axle, double-decker buses, and 12
5 meter single deck buses. And at this point, I will ask Tom
6 Apalenek, Senior Systems Engineer, to come up and talk to
7 you more specifically about fuel cells.

8 MR. APALENEK: Good day, everybody. And this last
9 slide that John put up here kind of shows our experience
10 over the years. We have been working on hybrid electric
11 and, actually, fuel cell vehicles, since about 1996, and in
12 the bottom row there, the bus on the left is a fuel cell bus
13 we did with Georgetown University back in 1997. And we did
14 a second one with them in '98, '99. We have also done
15 chargers for all-electric vehicles, and we are looking at
16 re-exploring that market as we move on. One fuel cell
17 program that we are working on currently, which is a little
18 bit unique in the fuel cell bus area is we are working on
19 what is called a compound hybrid fuel cell bus, this is a
20 program through the FTA in conjunction with CalSTART out
21 here. This is going to go into revenue service testing in
22 March of next year at MUNI in San Francisco, and essentially
23 this is a diesel hybrid electric bus with a fuel cell power
24 unit on the roof to provide all the auxiliary power for air
25 conditioning, power steering, lighting, air compressor, and

1 so on. We are using our next generation system and
2 electric accessories that we are currently integrating into
3 the bus, and we are trying to combine the best of both. One
4 of the key ideas behind this was to help provide a means of
5 commercializing fuel cells a little earlier in the process
6 by using a smaller lower powered fuel cell, so that we could
7 start to bring them into commercialization, rather than
8 going with the full size power plant. Also, this
9 demonstrates the electric accessory technologies, and I know
10 Paul from ISE talked about electric accessories on those, on
11 their systems, which are key to commercializing fuel cells.
12 And I kind of already covered this, but how does the hybrid
13 activity support alternative fuels and hydrogen initiatives?
14 And the key part of it is that all of the technologies that
15 we have to develop for the hybrid vehicles, particularly for
16 a series hybrid vehicle, are the same technologies for the
17 rest of the vehicle that have to be developed and
18 commercialized for a fuel cell bus, so it truly is the path
19 to the future.

20 This is just showing some of the product
21 improvements that we have made. John mentioned that we have
22 got several hundred of the lithium ion energy storage
23 systems that have gone into production now. The previous
24 system was lead acid, we have upgraded to that. The other
25 key part that we are adding to our next generation is

1 support for electric accessories and the integration of
2 electric accessories, again, key to fuel cells. And
3 actually, the lithium ion, I will talk to in a minute here.
4 That is going to be very key to supporting fuel cell
5 programs in the future because of the weight reduction.
6 Again, electric accessory support, all the cooling systems,
7 air compressor, power steering, air conditioning, auxiliary
8 systems clearly have to be electric for fuel cells.

9 This is our next generation traction system, it is
10 a little bit of an upgrade from the previous system that is
11 in service in a lot of the cities today, and we call this a
12 modular traction system and the key part about it that is
13 modular, if you look at the picture on the lower right, that
14 is our system attached to a standard diesel engine. One of
15 the things that we did to simplify integration for the bus
16 OEM's was make it so that it looks very much like a
17 transmission, but one of the key aspects of it is that the
18 generator that is needed with the diesel engine system
19 literally comes right off of the traction motor, so you
20 could separate it and just use the traction motor portion of
21 it.

22 Some future vehicle development plans that we are
23 doing today. We are working with CalSTART, some of the
24 ZTUG* [66:09] partners, and a number of leading suppliers of
25 fuel cell, buses, hydrogen fueling, toward the development

1 and the deployment of 50 or more -- we would like to see it
2 more -- fuel cell buses in multiple states, including
3 California. Right now, at least 25 buses are targeted for
4 deployment in Southern California. All of the technology is
5 based on proven systems from each of the team members, and
6 our goal, if we can get funding for this, is to get these
7 vehicles deployed before the beginning in 2012. And one of
8 the key things that we are hoping here is that a larger
9 fleet size will help to bring down those costs.

10 In the agenda, there were some panel questions
11 that you had asked that we try to address, and I put a
12 couple of the key ones up here. Regarding challenges and
13 opportunities, I do not think that we are aware of any
14 challenges other than the main ones that are known out there
15 today, which is fuel cell cost obviously has to come down,
16 robustness of service life needs to be improved, and,
17 actually, in the morning session some of the other
18 automotive suppliers, some of the things that they are doing
19 with the fuel cells was very encouraging in that area, so
20 hopefully the automotive marketplace will help with some of
21 those things. And obviously the hydrogen fuel sources and
22 facilities.

23 As far as opportunities, and I will talk about
24 this in conjunction with the overlooked applications, I
25 think one opportunity that we see that can really help in

1 the heavy duty market, particularly with transit, is to
2 look at the retrofit option. One of the things that we have
3 talked about whenever we have made presentations is that a
4 series hybrid bus is fuel cell ready, we have called it,
5 because all of the components are the same. But we have
6 always talked about it in terms of generalities, and I think
7 one opportunity for funding that might really help spur this
8 on would be to do a specific demonstration program to
9 develop two vehicle types, a CNG hybrid bus, and what is key
10 about that is, by going to lithium ion and some of the more
11 advanced energy storage and reducing the weight of the
12 system, you can now make a CNG hybrid practical and have it
13 fall within the weight that you need a transit bus to be,
14 and then the second bus type would be a fuel cell bus, and
15 the key part of this demonstration would be that you make
16 the two buses 100 percent identical, except for the power
17 plant. And the key thing that this does is it provides a
18 mechanism where transit operators could begin ordering CNG
19 hybrids that truly are convertible to fuel cell as soon as
20 the fuel cell power plants become commercially available
21 because they would be able to literally pull it out, pull
22 out the engine, and the generator portion of the system,
23 this could be done at the six-year major overhaul interval
24 that a lot of transit operators do, and also any existing
25 orders for those in the future, when in production, could be

1 converted from CNG to fuel cell at the OEM's factory,
2 again, when the fuel cells become available. So I think
3 that is an opportunity that would be worth looking at as a
4 future possibility. And this is just basically a little
5 graphic illustration of that, you have got the system, you
6 pull out the engine and generator portion of the system, and
7 you put in a fuel cell power module, and the rest of the bus
8 remains untouched.

9 So, in summary, I think all of the people that are
10 working on hybrids, and particularly series hybrids today,
11 that experience applies very well to the fuel cell
12 technology. The series hybrids supports the future goals.
13 We currently have thousands of vehicles in service proving
14 the technology, so we know that that portion of the
15 technology is reliable and, of course, you get all the
16 quieter operation, smoother ride. Retrofit options, I
17 think, re a key one that needs to be looked at, and we
18 believe that we can be a reliable systems partner for that.
19 Thank you.

20 MS. BAROODY: Thank you, Tom and John. Any
21 questions?

22 MR. OLSON: Yeah, a couple questions. This is Tim
23 Olson. So your recommendation on a demonstration program --
24 is that something that you have the capability of doing both
25 of those, the CNG hybrid and the fuel cell bus?

1 MR. APALENEK: Yes, we do. We have worked on a
2 number of fuel cell bus programs, actually, one of the
3 vehicles that was in that large picture of all those
4 vehicles actually was a CNG hybrid. We did a CNG hybrid
5 taxi for New York City a number of years ago as a
6 demonstration program with NYSRTA. So we have experience
7 with both of those.

8 MR. OLSON: And would you work with other vendors
9 on that? Or do you manufacture everything yourself?

10 MR. APALENEK: No, no, we would work with a fuel
11 cell partner for the fuel cell portion of it. We would work
12 with a bus OEM for the actual vehicle, so it would be a
13 partnership.

14 MR. OLSON: And do you have any of your
15 manufacturing in California for assembling?

16 MR. APALENEK: At present, the manufacturing is
17 not in California. We have a number of facilities in
18 California, and we are actually looking at making California
19 into an application center, where we would be able to do
20 integration field service.

21 MR. MADDUX: The fuel cylinders are built at SCI
22 in Pomona, and the cage for the fuel cylinders is built by a
23 --

24 MR. APALENEK: Fab Industries, Inc. Yeah, some of
25 the partners that we are working with are in California for

1 some of the components on this current bus. And actually
2 the hybrid -- the compound hybrid that I mentioned, all of
3 the integration with the fuel cell portion of that is going
4 to be done in Ontario, California.

5 MR. OLSON: And do you have any similar
6 information that the Vision owners, the people describe in
7 terms of through-put for the hydrogen version of this? Fuel
8 through-put on an annual basis?

9 MR. APALENEK: I am sorry, fuel through-put, or
10 number of vehicles?

11 MR. OLSON: Hydrogen fuel through-put?

12 MR. APALENEK: No, I do not have any data on that
13 at this point. We can certainly develop that and provide
14 you with some estimates and projections.

15 MR. OLSON: And what did you say the cost of your
16 prototype was, and where you are going on the next step?

17 MR. APALENEK: The cost of the prototype,
18 actually, I do not have for you. John may be able to
19 provide that, the FTA program, I know, is the public
20 information. I do not know if you want to address that,
21 John?

22 MR. MADDOX: That particular program runs for
23 three years and it is approximately \$5.6 million program,
24 but there is a lot of support that goes with it beyond the
25 vehicle itself. The 50 bus consortium, we mentioned

1 earlier, you know, the price to win goal there is \$1.8
2 million.

3 MR. OLSON: Okay, very good. Thanks a lot.

4 MS. BAROODY: Thank you again. Next up, we have
5 David Pfeil with Plug Power.

6 MR. PFEIL: Thank you. Now, I want to talk about
7 Plug Power and what we do. I am primarily going to focus on
8 the hydrogen infrastructure to supply our project, which is
9 one of our major challenges at this point. Plug Power, our
10 market is electric lift trucks. We replace the lead acid
11 battery with hydrogen fuel cells. The different classes
12 that we target, Class 3, is the pallet trucks, Class 2
13 stand-up reach trucks, and those two are typically lumped
14 together in the high through-put fuel distribution industry,
15 companies such as Wal-Mart, Target, Kroger's, etc. And then
16 the sit-down lift trucks, those are mostly in the
17 manufacturing industry, Bridgestone, carpet manufacturers,
18 etc. And what our customers want is a product that simply
19 plug-in play, so it replaces the lead acid battery with the
20 hydrogen fuel cell, so they do not have to replace their
21 lift truck, itself, but just take out the battery, put in
22 the hydrogen fuel cell, and they operate as normal.

23 So the material handling business in California,
24 it is a multi-billion dollar North American market. And
25 there is a large opportunity, obviously, to supply

1 California, which is one of the biggest states in terms of
2 the materials handling market. So in California, there are
3 over 50,000 electric lift trucks operating in the large
4 fleets, and we typically are only going after large fleets,
5 not the one or two installations, so it is mostly the high
6 through-put. And this provides California and it provides
7 different states with the ability to roll out distributed
8 hydrogen re-fueling. So if you look at each warehouse, it
9 is up to 300 plus kilograms a day of hydrogen, it is high
10 utilization rates, so these are operating 20-24 hours a day,
11 seven days a week, and obviously using hydrogen. It is a
12 predictable and rapid adoption rate, so when you sell the
13 lift truck, you provide the hydrogen station with it, so it
14 is not like automotive where you have to first install the
15 fueling stations and then wait for the vehicles to catch up,
16 this, you install at the same time, so there is no --
17 typically wasteful by the industry -- the chicken and egg
18 scenario. And then, also, because you are not charging lead
19 acid battery, you are reducing the load on the grid, and the
20 options obviously for renewable hydrogen where you can get
21 clean green hydrogen to the lift trucks.

22 Also, we have spoken to a lot of the customers are
23 leveraging the hydrogen infrastructure at their sites and to
24 be able to use it for automotive or truck fueling, as well,
25 so there is an option for that. The hydrogen fueling at

1 materials handling sites is typically the same as for
2 automotive, you know, you have your installation, you have
3 your components, your hydrogen supply, your compression and
4 storage, etc. The biggest difference is that we have indoor
5 dispensing, so we need to dispense these lift trucks inside
6 the warehouses, they do not go outside. And so we need to
7 safely and effectively do it indoors, and that is our
8 strongest value proposition is making sure that the lift
9 truck operators are on the floor doing their work, as
10 opposed to changing out batteries, and then the operation,
11 as well. And typically that is how the hydrogen to the
12 customers is processed, a fixed portion which is the
13 installation, and then the capital costs, and then the
14 operating costs, which is the hydrogen molecule, and the
15 maintenance.

16 Installations, so we have inside a distribution
17 center, these are on the order of magnitude of about a
18 million square foot. We have sort of two to five dispensers
19 typically installed within the distribution centers at
20 various points that makes sense to the operation. And we
21 have either, if you can see on the top left here, we are
22 running the tubing on the roof of the distribution center,
23 we have also run it in the trusses inside, or on the walls
24 and we have also done in new distributions, we have run the
25 hydrogen piping under the floor before the concrete is laid,

1 and then stub up at the dispensing points.

2 This is an Air Products also liquid supply,
3 horizontal tanks, and these are industrial settings, so we
4 comply with NFPA, all the international codes, and make sure
5 that the setbacks, etc., are within code. Luckily, most of
6 the places have enough space where we can adequately site
7 the liquid tank, and that is mostly what we have used is
8 liquid supply at the distribution centers. But we work with
9 the fire departments, the code officials, etc., to make sure
10 that we have all the correct permits and approvals to
11 install these systems.

12 So supply and compression, I am sure most of you
13 are familiar with these. This is an Air Products site with
14 a vertical liquid tank, so the liquid tank vaporizes
15 compression, and then high pressure storage, and those are
16 all situated outside the distribution center.

17 This is a Linde system where the liquid tank
18 obviously arrives and discharges to the liquid storage
19 tanks, which are located on site. We also are looking at
20 natural gas reforming, which is the potential and we are
21 looking to see if that makes economic sense, as well. All
22 the places we have done it thus far, it has not made
23 economic sense to do that, and we have just used liquid
24 supply.

25 This is another Linde installation, and what one

1 of the biggest, most critical factors at these distribution
2 centers is making sure that there is reliability of supply
3 because, the way they are operating, if we stop supplying
4 them the hydrogen, their product is sitting on their floor,
5 not moving, and all the premise with just in time supply,
6 that obviously cannot happen. So we built in a lot of Linde
7 products and we work with both a lot of redundancy to ensure
8 that we have continual 24/7 supply of hydrogen. And here
9 you can see the containers contain the compression and
10 storage, and there is some redundancy in there, as well as
11 the vaporizers.

12 Indoor dispensing, pictures of two Air Products
13 dispensers, we have stand alone ones, as well as wall-
14 mounted dispensers. We have on the Class 2 and 3, which is
15 the grocery distribution, we have 250 bar pressure, and
16 then, on the Class 1's, which is the largest sit-downs, we
17 have 350 bar pressure.

18 If you look, these are Linde stations and, up to
19 now, we have worked mostly with Linde and Air Products. If
20 you look at the top left hand with the operators fueling the
21 lift truck, we have three connections, we have the hydrogen
22 connection, we have the de-watering connection, which
23 removes the water when we are fueling, this allows, because
24 these lift trucks work in the freezer operations, which goes
25 to -20, we cannot have truck vaporized water and we cannot

1 leak water onto the floor, because that is a safety hazard,
2 so we store it and then remove it during fueling. And then
3 we also have a ground and data cable, as well, which we
4 connect when we do fueling.

5 So the plug power commercialization status to
6 date, so today we have over 1 million operating hours of
7 fuel cells in lift trucks, and this is at customer sites,
8 this does not include our testing, these are commercial
9 sites and commercial operation. We have just over 106,000
10 fuelings, as well, without any safety incidents to date.
11 The only instance we have is driveways, so operators pulling
12 away with the hydrogen hose still attached, but the
13 breakaway has worked on most occasions, sometimes we have
14 damaged the nozzle, but we have not had any releases of
15 hydrogen in those instances either. So right now, we are
16 averaging about 330 Kilograms per day of hydrogen, and we
17 expect our projection to more than double by March of next
18 year.

19 These are some of our current customer -- Wal-
20 Mart, Bridgestone, and above the line is other customers
21 that are currently installed and currently operating. Below
22 the line are the customers and the locations that are under
23 construction, or about to start construction. As you can
24 see, most of them are in -- we have not had any in
25 California, as yet.

1 This is a picture of the roll-out at a company
2 called Central Grocers. They are based just outside of
3 Chicago in Illinois and they were our first Greenfield site,
4 so it was a distribution center which was made full purpose
5 for hydrogen and did not have any battery charging
6 infrastructure in, and this was our first order of 140 lift
7 trucks which obviously fit into the Yale lift trucks, pallet
8 trucks.

9 So barriers to commercialization in California,
10 there is a strong interest from companies here because of
11 higher electricity costs, as well as they see the
12 productivity benefits that they have been getting from using
13 fuel cells, as opposed to acid batteries. Our largest
14 barrier at the moment is hydrogen competing against the grid
15 electricity. The companies know what the cost structure of
16 doing this, and we need to break through into that, and we
17 need first movers, and then we have seen in other parts of
18 the country that other people learn and follow. The
19 companies with their head offices outside of California,
20 they are looking at the moment and doing business where
21 there are states that are giving funding, for instance, a
22 company called Wegman's, their head office is in New York,
23 but they just did a project in Pennsylvania because they
24 just received funding from Pennsylvania State.

25 So what we are looking for is incentive to the

1 customer up front and to cover the costs, with a portion of
2 the cost of the installation costs of hydrogen, and which
3 obviously reduces their ongoing operating costs. And we are
4 working with them and working out of different sites, we are
5 getting customers to overcome the scare of the dark type
6 perception of hydrogen and the complexities thereof, and we
7 are getting them to work with Linde and Air Products to try
8 to simplify the hydrogen and the cost structure to the
9 customers. So that is what we are looking for, so short
10 term incentive which will immediately bring customers online
11 in California, and then help and cause other people to
12 follow suit. Thank you.

13 MR. BAROODY: Thank you very much, David. Are
14 there any questions?

15 MR. OLSON: Yeah, I have a question. Can you just
16 walk through some of the cost benefits of hydrogen? So you
17 are displacing, you said, the acid battery --

18 MR. PFEIL: Correct.

19 MR. OLSON: And I can see where that might be
20 beneficial just from the time spent not moving product and
21 dealing with -- can you describe what that cost differential
22 might be? Or what the benefit is?

23 MR. PFEIL: It is mostly in the labor cost, you
24 know, if you look at a site which has around 300 lift
25 trucks, and each operator, when they change their battery,

1 it can take, you know, if there is no line-up, it can take
2 10 minutes to change it. If there is a line-up, sometimes
3 it takes them 30 minutes to change that battery. And their
4 run time is a lot shorter, as well, on a battery versus a
5 hydrogen fuel cell, as well as with a lead acid battery, you
6 get -- as everyone knows, with batteries you get a battery
7 drip, the AC technology has taken care of some of that, but
8 you still get some drip in your battery, whereas a fuel
9 cell, on our technology, it takes approximately 30 seconds
10 to two minutes to fuel. And then you are not getting any of
11 that battery drip, so it is operating like a fresh battery
12 all the time. So if you look currently on payback, which is
13 what most of the customers look at, they are looking at sort
14 of under two-year payback, and that is what we -- on the
15 ones that have gone commercial -- we offer that.

16 MR. OLSON: You had mentioned that you thought
17 California was a \$50,000 lift truck market. What is the
18 turnover on that? What is the annual turnover? Is that --

19 MR. PFEIL: Well, in the U.S., you are getting
20 about 175 to 2,000 sales of new lift trucks every year, so I
21 have not broken that specifically to California, but that is
22 what you are getting within North America. But our product
23 can fit into the existing fleet, we do not have to wait for
24 new product, new lift trucks.

25 MR. OLSON: Have you been approached, or have you

1 looked at this potential business model of combining your
2 big box warehouse type of operations with maybe some of the
3 transit or potential truck -- more industrial -- is there a
4 potential to locate a fueling site that would benefit both
5 on-road, medium duty, heavy duty, maybe, and also your
6 forklift -- your lift truck?

7 MR. PFEIL: Yeah, there is. And we have spoken to
8 customers, as I say, like Wal-Mart and Kroger's, and people
9 like that about it, and there definitely is -- you could use
10 the infrastructure that is outside the warehouse and have a
11 automotive style dispenser at their location. We are
12 currently doing that at Aiken, actually, where we supply --
13 our infrastructure is going to supply two warehouses, and
14 then it has an automotive style dispenser, as well.

15 MR. OLSON: And what is the lift truck, whether it
16 is electric or hydrogen, what is the base cost on that?

17 MR. PFEIL: A pallet truck is probably around
18 \$10,000, if I remember correctly, around there, and they can
19 go up to \$20,000 or \$30,000.

20 MR. OLSON: Okay, thanks very much.

21 MS. BARODY: Thanks, David.

22 MR. PFEIL: Thank you.

23 MS. BARODY: We have an addition to this panel,
24 and that would be AC Transit, Jaimie Levin.

25 MR. LEVIN: While she is pulling up my

1 presentation, I direct the Alternative Fuels Policy Program
2 for AC Transit, which is a fancy description of what I
3 really do, which is to run our Hydrogen Fuel Cell Program.
4 And so let me just start out by acknowledging what Peter
5 said at the start of this workshop, that what the state
6 would like to see our model projects and model development
7 efforts that can be really an example to the rest of the
8 world, and anyone who knows what we have been doing at AC
9 Transit, which is now expanding to the Bay Area Region,
10 anyone who knows this project in terms of what we have
11 accomplished, what our goals are, what our prospects are for
12 the future are, will clearly acknowledge this is an
13 international project, it is largely funded by the state of
14 California, and our objective is to keep rolling, and so let
15 me give you a quick background as to where we are and where
16 we are going, and what the Energy Commission can do to
17 support that effort, and in fact has been supporting us in
18 some measure.

19 So Phase 1 of the project, which has been in
20 operation for three and a half years, been funded to over
21 \$21 million -- public, private contributions, and the Energy
22 Commission actually gave us a million dollars early on to
23 fund the station that we built with Chevron. The
24 performance in the last three and a half years has really
25 been quite remarkable. You can see that we have reached

1 close to 200,000 miles of passenger service, we have
2 carried over 450,000 people. We are getting 70 percent
3 better fuel economy, even though these vehicles are 8,000
4 pounds heavier than their diesel counterpart, which we do
5 careful testing with a control fleet. And also interesting
6 to note is that the fuel cell buses utilize air
7 conditioning, which is a pretty heavy parasitic load. The
8 control diesel fleet does not have air conditioning. So
9 that fuel economy number is something that we are very
10 excited about in terms of performance. And even though we
11 make our fuel by reforming natural gas at our Chevron
12 station, our grid analysis shows a 43 percent reduction in
13 greenhouse gases. So you can imagine with renewable fuel
14 what the ultimate benefit is. And then, fuel cell
15 durability has been climbing steadily. Our partner is UTC
16 Fuel Cells, we are seeing some phenomenal numbers, which I
17 am not at liberty to share with you under NDA, but it is
18 showing us as the end user, that there is really potential
19 here for our industry. The public? They love this. I
20 think the gentleman from GM talked about how people love
21 driving the cars. The people love riding our buses. I am a
22 bus user, I take a fuel cell bus to work, believe it or not,
23 and that is entirely coincidental. But the bottom line is,
24 these vehicles are quiet, they are smooth, they represent a
25 different mode and our public loves it and wants us to

1 continue.

2 So second phase of our expansion, which we are
3 involved in now is over \$50 million, funded by a variety of
4 sources. Now, one of our goals beyond proving the
5 technology is to replace the guy in the lower left photo
6 with this guy, but for those people who are not in the room,
7 but are on the Web, I want to offer a disclaimer, this is a
8 Photoshop version. But, in fact, we have received a major
9 stimulus grant from the Obama Administration, and we believe
10 our next generation vehicle is going to really open up the
11 doors, the gateway for what we think will change our
12 industry.

13 This next program is a Bay Area program, Gerhard
14 referenced that, it is not just AC Transit, although we are
15 the lead, it is these other four transit operators that are
16 working in partnership with us. What is really exciting
17 here is I am going to go over just some of the very few
18 basics of this new design. What makes it different from our
19 existing vehicle design, of which we are building 12 of
20 these, first of all, we are 6,000 pounds lighter, so this
21 new bus is only 2,000 pounds heavier than a diesel bus,
22 secondly, it has been fully integrated by an OEM, and we
23 have realized significant benefits in component design and
24 engineering, as well as the weight. We are introducing
25 lithium ion batteries in this technology, actually by a U.S.

1 company, Enterdale* [95:03], which recently received a big
2 stimulus grant for their efforts, and our fuel cell warranty
3 is up to 10,000 hours with this new vehicle. So our
4 objective with the vehicle is to show that it is fleet
5 ready. But, if we are going to convince the industry and
6 our decision makers that this technology is in our future,
7 we have got to do more than show that the vehicle works, we
8 have got to show that the infrastructure and the fueling
9 side of this works, as well. We have to expand from our
10 current capacity of 150 kilograms per day to over 400, and
11 to help us with that, we just received, I mentioned, a
12 stimulus grant from FTA in the amount of \$6.4 million, which
13 will go towards a solar installation to expand our solar
14 capacity, to 1.7 Megawatt hours per year, and all of that
15 power is going to go into renewable hydrogen so that we can
16 satisfy our CARB grant for light duty fueling at our
17 Emeryville station that we are building, as well as provide
18 green power for our efforts at our Oakland site. Our
19 Oakland station, which we run now, we produce over 41,000
20 Kilograms of fuel, and this has been a great partnership
21 with Chevron. But, quite frankly, we have been spoiled.
22 And Chevron has done a fair amount of investment and been a
23 marvelous partner, but there is not a business case for them
24 right now, so we have to go out on our own and find a
25 partner and a company that we can make this more commercial,

1 and we have out on the street, as we speak, a solicitation
2 to build two new hydrogen stations, one for Emeryville, and
3 one to replace our Chevron station in Oakland, and we have
4 some hungry companies in the industrial gas business that
5 are preparing their solicitation, some of them I see sitting
6 in the audience, I thought they would be at home working on
7 their proposals, but whatever.

8 So what do we need to do on the infrastructure
9 side to bring this to commercialization? First of all, we
10 have to be able to fast fuel our vehicles. We have hundreds
11 of buses that are fueled in five to seven minutes, each. So
12 that is a labor issue, just like the lift truck dilemma, as
13 well. Secondly, we have to be more energy efficient and
14 reduce -- try to keep our costs down and fuel production,
15 thirdly, we need to push towards a green footprint solution,
16 and then, lastly, it has to be scalable.

17 Our current program is three buses, we are growing
18 to 12, we see ourselves as the center of excellence, we want
19 to be able to go to 20, 30, 50 buses, and do it fairly easy.
20 Here is the station in Emeryville that we are moving forward
21 with, and we are looking with our partners on the auto side,
22 Hyundai is a partner with us now, we are looking to both
23 Toyota, Daimler; GM and Honda have expressed an interest to
24 actually use this Northern California station, which is
25 right across the street from Pixar Studios. There are some

1 images of what the station would look like from the street
2 side, with respect to public access, and then you can see
3 how we share the bus and the private or light duty fueling
4 at the same location. We have a continuing evaluation
5 program with DOE and the National Renewable Energy Lab to
6 track what we are doing. And we also have a pretty
7 aggressive education program that we work through U.C.
8 Berkeley's Lawrence Hall of Science, reaching out to all of
9 our high schools, secondary schools about the work that we
10 are doing.

11 Here are our next steps. The 12 bus program is
12 what CARB is looking at very closely in this next year. But
13 we hope, with these new buses and this new infrastructure,
14 to really be able to grow this as a center of excellence to
15 up to 50 buses, and prove to our industry that, indeed, this
16 is our future. So the punch line to this presentation,
17 which I will direct to the Energy Commission, is that we
18 responded to the last solicitation, we put a dynamite
19 proposal together, but we were rejected right up front
20 because the Oakland station that we are seeking additional
21 funding for is not a true public access station, it is an
22 industrial area, it is very difficult to get to the fueling
23 pumps where there are located, as opposed to the Emeryville
24 station, which is very accessible to the public. And here
25 is this state project that is world renowned, in which we

1 are not asking for, in the fleet application, for a
2 multitude of stations, we are asking for funding to build
3 one station as part of this demonstration which has so much
4 potential in terms of vision and future. So that is what I
5 pose to the Commission and the workshop effort, is that you
6 consider some aspect of the state's funding going to fleet
7 applications that do not necessary have public access. If
8 we can provide it, we will be the first at the door to do
9 it, but that is not something in many locations, for fleets,
10 it is not something that we can easily do. So with that, if
11 there are any questions, I think we are way over time for
12 the next round.

13 MS. BAROODY: Thanks, Jaimie.

14 MR. OLSON: Jaimie, this is Tim Olson. What does
15 it cost for these buses?

16 MR. LEVIN: Well, let me start with -- the first
17 buses were \$3.2 million a piece. These buses are \$2.5
18 million a piece, not acceptable numbers when a diesel bus,
19 we can buy with the 2010 emissions standards at around
20 \$400,000; however, when you look, especially on components
21 with the fuel cell box, there are some handmade pieces,
22 manifold pieces, that you could probably buy at a Home Depot
23 for \$100, but which cost maybe \$12,000, \$15,000 to make for
24 these research vehicles. So supply chain economics have not
25 kicked in to this. And this, I think, came up previously --

1 what is the state's role? What is the federal government's
2 role? That role is really to enable these visionary
3 technologies, if we can prove performance. And it is going
4 to take -- to get across the Valley of Death -- it is going
5 to take some investments. And it is not the state's
6 responsibility alone, it is the federal government is going
7 to have to step in because, in the end, it is a public
8 policy issue of is it worth it to us to have silent vehicles
9 in our neighborhoods, to have zero emission in urban
10 neighborhoods, is it worth it to us to really do away with
11 reducing greenhouse gases, so long answer to your question,
12 but I think it is important to realize that we are driving
13 the costs down, and the state, as well as the federal
14 government, can help realize that objective.

15 MR. OLSON: And what is the cost of your fueling
16 station that you are looking at in Oakland?

17 MR. LEVIN: Well, I can tell you what the budget
18 is, but I maybe even should not say that because we have got
19 some people in this room who are bidding on our hydrogen
20 systems. I hope to be able to come back in another month, a
21 month plus, to tell you what those costs are. I can tell
22 you that, for the Chevron station, we put \$2 million into
23 that project and Chevron put in a whole lot more than that,
24 as a research station, and it is not realistic to what the
25 true costs are, and we want to be able to come back and

1 share with you what they are costing us in order to get
2 this rolling.

3 MR. OLSON: Yeah, just a comment on -- I think it
4 is a good point you are making about the public access.
5 This needs to be on the table for this next round of funding
6 or even, for that matter, this round that we are going
7 through now. And part of the rationale for that from our
8 Commissioners was that we have got 20 some odd stations
9 throughout California, and many of them are not operating or
10 they are not public access, so it just kind of minimizes the
11 use, and we did not want to repeat that. So I suspect that
12 is a smarter spending of money and strategic targeting of
13 where we actually put money.

14 MR. LEVIN: I understand that point of view, but I
15 would just ask you to consider what we have accomplished
16 with the state's money and investment, this is a world
17 renowned program, not just because we have got all these
18 miles and fuels consumed, and what have you, but we have
19 developed technology with a true prospect for the future.
20 So we would ask you in this round to open up at least some
21 portion of that funding to fleet applications. I think the
22 LA project with trucks, and the lift truck projects, those
23 are other fleet operations that I think merit attention, as
24 well, even though I might be competing against those
25 projects, but I think they all merit consideration.

1 MR. OLSON: And do you own the fueling station,
2 AC Transit?

3 MR. LEVIN: We do own the fueling station, and we
4 will own these other fueling stations, as well. But the
5 Chevron station was really a very advanced R&D effort, and
6 so, with our agreements with Chevron, we will be
7 decommissioning that station to make way for the new station
8 that these companies are bidding on, as we speak.

9 MR. OLSON: Okay, thanks a lot. I appreciate your
10 comments.

11 MS. BAROODY: Thank you, Jaimie. We appreciate
12 it. Okay, we are going to take a real quick five minute
13 break and we will be back at 2:55 with our next panel.

14 [Off the record at 2:56 p.m.]

15 [Back on the record at 3:05 p.m.]

16 MS. BAROODY: Next up is our Fuel Production and
17 Distribution Panel. Is Dr. Tim Brown available? There he
18 is.

19 DR. BROWN: Hi. I am Tim. I want to thank the
20 Commission for letting me speak today. I am going to talk
21 about UCI's views on the whole hydrogen fuel cell vehicle
22 subject.

23 Transportation problem -- before we look at
24 alternatives, we need to define the problem, and I think the
25 transportation problem is being driven by three forcing

1 functions, which you are all very familiar with. Of
2 course, there is air quality, and that can be summarized
3 here in California by the Carbon Strategic Action Plan, the
4 strategic plan, as well as the EPA Natural Ambient Clean Air
5 Standards, Global Climate Change, again, California AB 32
6 and Pavley Bill, and last but not least, petroleum
7 dependence, which leads to many things, including
8 geopolitical instability, price uncertainty, on down the
9 line. But these three forcing functions do not stand alone,
10 they are all integrated, tied together by one common theme,
11 and that is market acceptance. No vehicle option can meet
12 these three goals without being accepted by the market. So
13 any successful alternative is one that will meet the needs
14 of the consumers and the economy. And we believe fuel cell
15 vehicles are really the only option to this point that can
16 do this -- meet our goals, and meet the needs of society.

17 Continuing on, to talk about greenhouse gas
18 emissions, the little picture there. The well to wheel
19 greenhouse gas emissions are drastically reduced, regardless
20 of the mix of hydrogen generation technologies. We have
21 done some modeling to show -- excuse me, my graphics are
22 kind of screwed up, you will have to give me just a second
23 for my graph to show up. We even went through this earlier
24 and it was working.

25 MS. BAROODY: Those of you online, we are just

1 fixing the PowerPoint presentation.

2 DR. BROWN: All right, greenhouse gas emissions
3 get reduced regardless of hydrogen generation method. On
4 the vertical axis, we have greenhouse gas emissions and CO₂
5 equivalent. This analysis was for the entire state of
6 California. On the horizontal axis, we have two different
7 scenarios, one for 2030 where we assume a 12.5 percent
8 penetration of hydrogen fuel cell vehicles, and the other in
9 2060 where we assume a 75 percent adoption of vehicles, and
10 for each scenario, we have three bars, orange being a
11 baseline case of gasoline vehicles. And it is important to
12 note that these are not today's gasoline vehicles, these are
13 future advanced, more efficient gasoline vehicles, as
14 projected by the CARB IMFACT* [5:10] model for each of the
15 years 2030 and 2060. And for each scenario, the blue bar
16 represents hydrogen that is generated from a more fossil
17 fuel scenario, so it is Scenario F, and the green bar
18 represents hydrogen generated from more renewable sources,
19 so that is Scenario R. And there are two sort of important
20 takeaways from this, the first being that, for either
21 scenario, the hydrogen fuel cell scenario, for either fuel
22 cell scenario, reduces greenhouse gases significantly
23 compared to baseline gasoline vehicles. The other important
24 thing is that, regardless of the hydrogen generation
25 scenario, be it more fossil fuel or more renewable, there is

1 not too much difference in greenhouse gas emissions. Sure,
2 the renewable case is better, and this renewable case
3 actually is the 33 percent case as proscribed by SB 1505.
4 So fossil fuel is not as good as renewable, but not
5 drastically. These results were published in the
6 International Journal of Hydrogen Energy.

7 Sticking on greenhouse gases, it turns out that
8 the greenhouse gas emissions for the vehicle scenario is
9 reduced regardless of the hydrogen delivery method, so,
10 again, same sort of graph. CO₂ emissions on the vertical
11 axis and three different categories on the bottom here, with
12 Scenario F, again, fossil fuel generation primarily,
13 Scenario R, more renewable generation, and a baseline case.
14 Now, both the fossil fuel generation and the renewable
15 generation includes some of each, just the renewable is more
16 slanted toward renewable fossil fuel, more slanted towards
17 fossil fuel, and here the orange line is the baseline case
18 of gasoline vehicles; of course, all the fuel of today is
19 delivered by truck for gasoline vehicles. The other two
20 scenarios, the blue line is for all truck delivery of
21 hydrogen and the green line is all pipeline delivery, so we
22 have bracketed the two bounds of how this may happen.
23 Realistically it is going to be a mix of both. But you see
24 that both cases are better than gasoline, and both cases are
25 relatively similar. It turns out that the delivery method

1 makes relatively little difference for greenhouse gas
2 emissions. And the last scenario for greenhouse gas here is
3 that it makes very little difference of where the hydrogen
4 is generated, whether it is on-site or a central location
5 with delivery. And a similar graph, CO₂ emissions vertically
6 and our two cases of 12.5 percent penetration, or a 75
7 percent penetration. You can see that the orange line,
8 again, baseline case, gasoline vehicles, the blue line is an
9 all distributed scenario, where all the hydrogen is
10 generated on-site, the green line is all centralized, where
11 it is all generated at a central location and delivered to
12 the stations. Again, for the outline case, 75 percent
13 adoption of these vehicles, the centralized case is not as
14 good as distributed because of the emissions associated with
15 delivery, but they are relatively similar and they are both
16 far better than gasoline.

17 Moving on to look at air quality, this same
18 modeling tool, which is called STREET that we have, Spatial
19 and Temporally Resolved Energy Environmental Tool, and we
20 can use this to go a step further than the greenhouse gas
21 emissions I showed to actually look at criteria pollutant
22 emissions, and the formation of pollution in the atmosphere.
23 And if we look at two scenarios here for hydrogen
24 generation, again, both graphs represent a 20/60 case where
25 75 percent adoption of hydrogen vehicles, a big portion of

1 the hydrogen actually generated in the areas shown here,
2 and this represents the South Coast Air Quality Management
3 District, rather the South Coast Air Basin, and you can see
4 Los Angeles, Anaheim, Riverside, try to get your bearings,
5 the left of this black line is the ocean. The plot on the
6 left shows eight-hour ozone concentration, again, 75 percent
7 vehicle penetration, a lot of hydrogen generated in the
8 basin. The plot is actually a Delta, it is a difference
9 plot showing how much improvement or how much worse the air
10 quality is compared to our baseline, and this is, again, a
11 baseline for the year 2060, so it has improved over today.
12 You can see that, in the Riverside area, out towards the
13 east, there is actually eight parts per billion in
14 improvement and an eight-hour ozone. The standard today is
15 75 ppb, so this is nearly a 10 percent improvement due to
16 the hydrogen infrastructure. On the right-hand side, there
17 is a particulate matter plot showing similar air quality
18 results for this time for particulate matter and, again,
19 there is nearly a 6 microgram per cubic meter improvement.
20 And these results were just published in the *Environmental*
21 *Science and Technology Bureau*.

22 Hydrogen displaces petroleum, not a very exciting
23 graph here. It is pretty straightforward. Fuel cell
24 vehicles can significantly lessen our dependence on oil.
25 The year 2030, both the fossil fuel and renewable case,

1 lower petroleum use, and in 2060, similar results. Again,
2 our fossil fuel generation of hydrogen in both cases
3 involves coal, petroleum coke, natural gas, it does not
4 involve any petroleum, so that is why there is no difference
5 between the renewable and fossil fuel cases.

6 Moving on to the market, again, this is in our
7 view a big bonus of fuel cell vehicles over other
8 alternative fuel options. Fuel cell vehicles provide ranges
9 competitive with current gasoline vehicles. And you have
10 seen this already today, several times, Kia Borrego, 426
11 miles, Honda FCX Clarity, 240 miles, Toyota FCHV-adv 431
12 miles, and from what I saw this morning, my numbers might be
13 a little low, actually. That is all I am going to say about
14 vehicles.

15 Moving on to infrastructure. We have a station at
16 UC Irvine. UC is just continually increasing. We initiated
17 the station as a research facility for a fueling and vehicle
18 research, but we have sort of moved beyond that point and it
19 has become the staple of refueling in the area. We are
20 currently operating near our design limit of 25 kilograms
21 per day. It is not uncommon to see two or three cars
22 waiting in line, actually, for fuel. Here is a plot of our
23 usage for the past four years, pretty dramatic increase each
24 year. Currently, as of mid-day last Friday, we dispensed
25 nearly 4,200 kilograms this year, which is already a third

1 more of the total for last year. So we are projecting out
2 for 2009 we are going to be nearly 6,000 kilograms this
3 year, so it is a pretty big increase in fuel each year.

4 You heard earlier today about the Fuel Cell
5 Partnership surveys, sort of a blind survey of the OEM's to
6 say how many vehicles are they going to introduce, and where
7 they are going to put them. The survey shows nearly 40,000
8 vehicles in Southern California by the year 2017. If we
9 plot the row out as produced by the Fuel Cell Partnership,
10 view the graph like this, very little action up until about
11 2014 and there is this huge spike in the number of vehicles.
12 If we do a very crude assumption here of, say, 1 kilogram of
13 fuel needed per car, per day, which is roughly what we are
14 seeing at our station now, and we go one step further and
15 assume, you know, a kilogram of -- a dollar of profit per
16 kilogram, maybe in the early years, early providers to the
17 market can make this profit. In 2013, it is \$330,000 per
18 year profit industry in Southern California, nothing to get
19 excited about, in 2015, \$3.6 million, and by 2017, it is \$15
20 million per year. If you look at the growth from 2015 to
21 2017, as well as the numbers, this seems like something that
22 could be profitable and enticing to fuel providers without
23 government incentive, I would think. I can let them speak
24 to that on their own. But are these numbers realistic? To
25 jump from 40,000 vehicles from 2015 and 2017? Compared to

1 the roll-out of hybrid electric vehicles in the same area,
2 again, this is Southern California, if we overlay these two
3 plots, you can see that the projected number of vehicles for
4 fuel cells are very modest, only about a third as many as
5 were actually sold for hybrid electric vehicles. If you go
6 a step further and look at, say, for the first four years of
7 hybrid electric vehicle sales, there are only two OEM's
8 producing cars. For seven years, there are only three
9 OEM's, whereas we heard this morning from six OEM's, we know
10 there are several others, as well, that are all looking for
11 commercialization around 2015. So the manufacturing
12 capacity and the probability of funding the market for this
13 number of vehicles seems very strong, and I would think this
14 number of 40,000 vehicles by 2017 could even be much higher
15 with the right market drivers.

16 How do we get from 2009 to this potential
17 commercialization? Infrastructure needs to reach a
18 threshold for commercialization. OEM's can only sell
19 vehicles if fueling is sufficient enough for normal day to
20 day requirements. Of course, this leads to the cluster
21 concept, where there are a number of stations in a localized
22 area. U.C. Irvine's STREET modeling tool can optimize the
23 station location in the near term to help overcome this
24 activation energy necessary for commercialization. The
25 modeling tool uses a roadway network optimization algorithm

1 as well as details about land use, travel density,
2 population centers, stakeholder input, and some OEM customer
3 data to help develop our station siting logic. So a
4 blueprint for hydrogen station clusters, if you look at
5 Irvine as a case study, we have applied this analysis to
6 Irvine, it turns out there are 34 gasoline stations existing
7 in Irvine, which is actually just sort of low per population
8 density compared to some areas. Eight well-placed hydrogen
9 stations can sort of reproduce the level of service that
10 those 34 gasoline stations provide, so if we show a map of
11 Irvine, you can barely see the gray outline of the outer
12 areas of Irvine, all the brightly colored areas in Irvine,
13 the two main roads here forming a V are the four or five,
14 and the five freeways give you some bearing as to where you
15 are at. We have placed eight hydrogen stations in here
16 using our optimization algorithm. The red area are places
17 that are covered by a two-minute level of service, so that
18 means that anywhere in that area, you can get to a hydrogen
19 station within two minutes. And this assumes -- this uses
20 real world driving speeds, you know, U-turns, one-way
21 streets, all the actual real travel times. Blue line is
22 three minutes, greenish is four, and yellow is five. You
23 see some areas of this gray that are not covered? Those are
24 actually undeveloped areas of Irvine that do not need to be
25 covered at the present time. To make this a little more

1 quantitative, we can compare the level of service of these
2 eight hydrogen stations to the 34 gasoline stations. You
3 see the bottom right here that 34 gasoline stations means
4 that 73.5 percent of Irvine is within five minutes of a gas
5 station. The eight well-placed hydrogen stations get you
6 66.4 percent of Irvine within five minutes of a hydrogen
7 station, not quite as good, but fairly competitive and we
8 believe this is over the threshold. Where the discrepancy
9 between the gasoline stations and the hydrogen stations
10 begins to show up is down in the three and two-minute areas,
11 where you see at two minutes you are still at 42 percent of
12 Irvine can reach a gas station in two minutes, whereas only
13 24 percent can reach a hydrogen station. So there is a
14 difference, but we believe the eight stations puts you at
15 the threshold. And if we go a step further and add two
16 stations that have been funded, shown here, one being the
17 OCSO station, Orange County Sanitation District, that we are
18 working with air products on, it has been funded by the ARB
19 and the AQMD, and the other station funded by the ARB is the
20 Shell hydrogen station in Newport Beach, and if we add the
21 travel times to those, we can begin to see how this cluster
22 expands, and if we go a step further and add our algorithm
23 to Newport Beach, we can locate five additional stations
24 there to round out the entire area of Newport Beach and
25 Irvine, as developed by the California Fuel Cell Partnership

1 Action Plan with their hydrogen communities.

2 So it is not just enough to determine where the
3 stations need to go, nobody is going to build seven stations
4 in Irvine overnight, we need to have a roll-out plan as to
5 when to put the stations in, and how best to do that. And
6 this is one particular scenario we have come up with where
7 we place stations one by one, and this addresses OEM needs
8 as to where their customer base most likely is, puts
9 stations near population densities first, and you can also
10 see how there is a progression, so there is some redundancy.
11 Oftentimes stations are not working properly, or whatever,
12 there is some redundancy built into this cluster approach,
13 and this just shows the first six stations.

14 So a final slide, what are our recommendations to
15 118 for investment strategies? Infrastructure. No surprise
16 there. Infrastructure planning. Renewable hydrogen
17 generation technology, that has become a bigger issue as
18 more stations need to get rolled out. Technology needs to
19 reduce fueling pressure, this is an efficiency hit and, you
20 know, storage issue that we think could be improved. Fuel
21 cell specialty vehicle deployment, we just heard about that
22 as, you know, all these mentioned markets including
23 forklifts, even buses or trucks to the port, not only have a
24 lot of benefit on their own, but can also help the
25 infrastructure and the technology for the vehicle sides with

1 the personal vehicle sides, as well.

2 Consumer vehicle usage behavior. This is an
3 ongoing subject if we are going to design a fueling
4 structure, do we necessarily want to duplicate what has been
5 done with gasoline stations? We still need some more
6 education as to how best to do this.

7 Hydrometric fuel cell, hydrogen tri-generation, I
8 did not talk much about this, but this is what we are
9 working on at the Orange County Sanitation District, it is a
10 technology that we have developed, that we are very high on.
11 It uses a hydrometric fuel cell to tri-generate heat,
12 electricity, and hydrogen for vehicle fueling, and we can
13 use various things as a fuel for this, including biogas.
14 Hydrogen compression technology. I think there are some
15 improvements that can be done in the compressor efficiency.
16 Hydrogen leak control. I do not see a lot of work going on
17 in these issues in the whole pipeline from generation to
18 delivery to dispensation. And consumer safety goes along
19 with that. Work in odorants or sensors. And last, but not
20 least, weights and measures, which we heard about this
21 morning, not only metering the fuel, but also guaranteeing
22 the quality. That is all I have. If there is any time, I
23 would be happy to answer questions.

24 MS. BARODY: Thank you very much, Dr. Brown. Any
25 questions?

1 MR. OLSON: Yeah, I have a couple questions.
2 Just going back on your greenhouse gas comparisons, in your
3 renewable source of hydrogen, did you include biomethane as
4 a feedstock?

5 DR. BROWN: We did for a portion of that. I have
6 the details that I can provide if you would like, actually.

7 MR. OLSON: Yeah, we would like to see it --

8 DR. BROWN: Now, I cannot tell you offhand which
9 portion that is --

10 MR. OLSON: If you are willing to share that so we
11 can check it with our pathway studies?

12 DR. BROWN: Okay.

13 MR. OLSON: The other question is about your
14 STREET model. Who are your clients for that right now?

15 DR. BROWN: We do not have any clients, we are
16 doing that independently. We are working with a number of
17 OEMs and providers for feedback, but we are not being funded
18 for it.

19 MR. OLSON: So you do not have any real -- it is
20 still kind of a research project, there is no --

21 DR. BROWN: Well, it is. The background, the air
22 quality modeling and these papers that have been published,
23 that was funded by the DOE CHIP program which included
24 Honda, Toyota, Air Products, that is a past effort, and that
25 funding is expiring or has expired. That was a five-year

1 effort to get us to the point where we are today. The tool
2 is actually extremely useful.

3 MR. OLSON: And does that model have the
4 capability of kind of mapping not just OEM hydrogen fueling
5 demand or need, but also other sources of -- other demand
6 sources for hydrogen and other alternative fuels?

7 DR. BROWN: Absolutely. It is very modular, so
8 right now we have applied it primarily, as I said, to Irvine
9 and/or the State of California for hydrogen, but the
10 versatility would allow us to look at other fuels, as well
11 as the entire pipeline of generation, to delivery, to
12 dispensation for any fuel.

13 MR. OLSON: And to what extent is fuel through-put
14 a significant factor in your model?

15 DR. BROWN: It is not currently because we feel
16 that the early issue is comfort for consumers to have a
17 station nearby, not so much the capacity of the station. We
18 feel that initially -- we have been siting our stations at
19 existing gasoline stations. If you can imagine one pump
20 initially being hydrogen, as capacity becomes more
21 important, a second pump would be made to hydrogen, build in
22 some capability to expand for these stations.

23 MR. OLSON: Okay, thank you.

24 MS. BAROODY: Thank you, Dr. Brown. If we could
25 have the panelists come forward to the tables here, we

1 forgot to call you up earlier. Charles is going to put up
2 the nameplates. Thank you. All set, okay. Next up with
3 Praxair, Tim Busch. Is Tim Busch here, with Praxair? Is he
4 on the WebEx? Maybe he missed the plane today. Okay,
5 moving on. Propel, Rob Elam.

6 MR. ELAM: Thanks and hi. I thought it would be
7 interesting to hear from a pure retailer's perspective on H2
8 opportunities and challenges, so I prepared a few short
9 slides. Propel is an alternative fuel retailer, an
10 alternative fuel retail platform. We have an interest in
11 hydrogen and learning about how we can apply our knowledge
12 taken from other retailing opportunities to the hydrogen
13 challenges. We are currently working on a project with
14 Linde -- Bob, it is nice to see you today -- SFO that was
15 funded by the ARB solicitation earlier this year. So we are
16 in that process. I think ultimately we have talked today, a
17 lot of discussion about the need for alternative fuel
18 retail, and for hydrogen retail locations, specifically.
19 But I think there is a question of who should take the risk
20 here and what are the costs associated with it. When you
21 ask a station owner or a retailer to take the risk
22 associated with opening a hydrogen fuel station, I think we
23 get a number of reasons why that is a difficult expectation.
24 The technology is very new, obviously, the operation and
25 maintenance costs of these facilities have not yet been

1 defined, and the ability to retail the fuel and demand are
2 really not yet clear.

3 When you talk to a fuel retailer, you will hear a
4 lot about unit economics, and from a unit economic
5 perspective, the three essential factors for a retailer are
6 what are the costs associated with the equipment and
7 overhead, the costs of managing and running the site, what
8 is the volume of fuel that can be sold and the margin
9 associated with that volume, which gets you to a break even
10 point of how many gallons -- how much margin do you need and
11 how many gallons do you need to sell to be able to cover the
12 costs associated with running the site. Above and beyond
13 that, then you have the opportunity to actually get
14 profitable for the site. Taking the assumptions as we know
15 them today, if you are talking about opening a site that had
16 50 vehicles associated with it, I think that we saw earlier
17 there was an expectation for a dollar a kilogram profit,
18 which would be, as a gallon equivalent unprecedented, but as
19 we see the actual need from a break even point of a 50-
20 vehicle station based on the data that we have from the
21 other alternative vehicles that we currently serve, we would
22 have to sell to cover all of our costs the fuel at
23 approximately \$101.00 per kilogram. So to sell the fuel for
24 \$102.00 per kilogram and make that dollar profit is actually
25 from a marginal -- that is probably achievable, but

1 ultimately nobody is going to pay \$101.00 a kilogram, and
2 we know that. I have my cohort out there, but he does not
3 have the right copy of our PowerPoint either.

4 So I guess fundamentally what we would look at
5 from Propel's perspective at this point is we do not have
6 enough definition into really what the costs are, what the
7 market looks like, we have worked with the fuel cell
8 partnership to understand what the OEM's are talking about
9 for vehicle roll-out's, we think that the concept behind the
10 clusters in Los Angeles is a good one, and that that is the
11 right approach, but we need to understand more from a
12 retailer's perspective to be able to step forward and really
13 make that commitment to operate a site. And in the absence
14 of that information, or even more well prepared with that
15 information, we would still be talking about costs that
16 would be largely -- the economics would not work from a
17 business perspective. And I think we all -- if we look
18 around and say, "Who is going to bear that risk? Where are
19 those costs going to be covered?" I think we know that the
20 private sector, investment sector, is not in a position
21 right now to fund hydrogen, and they have traditionally, you
22 know, there had been a period where they did fund a number
23 of aspects of hydrogen, they have sort of fallen off that
24 wagon a little bit, we need to know a lot more to be able to
25 go back with a fundamentally sound business case to be able

1 to get the private funding community back into the hydrogen
2 game here. So, from a timeline perspective for us, we would
3 like to see -- we are about a year, best case scenario, away
4 from being able to open up the station at SFO. Bob, do you
5 think that is about right?

6 MR. BOYD: Yeah.

7 MR. ELAM: So in about a year we will have a new
8 station with latest and greatest technology that is public,
9 and the other stations that were funded through this year's
10 ARB funding scenario should also be opening around that
11 time. We would then have the opportunity to gather real
12 world data with new updated equipment, get more current
13 operational maintenance costs associated with managing those
14 sites. We would like to see about a year's worth of data to
15 be able to really understand what we are looking at from a
16 risk perspective, from a capital deployment. So,
17 realistically, two years from now would be when we think we
18 would have the appropriate data to really look at starting
19 to -- I would not even say "scale," but starting to get out
20 of the R&D perspective, and into a more functional,
21 reasonable model for public access to hydrogen stations.
22 And moving faster than that, it would be difficult for a
23 company, a retail focused company like Propel, if not
24 impossible at this point, to be able to take the risks
25 associated, even if the State of California paid every dime

1 of the cost of the station, which in itself seems to be a
2 bit of an undue burden at this point.

3 So sorry I did not have my full PowerPoint here,
4 so a lot of that last part was off the cuff, but Propel is
5 very interested in helping to unlock the barriers to
6 widespread hydrogen roll-out, it is extremely costly, there
7 are not a lot of vehicles out there right now, we have seen
8 some movement that looks encouraging in that direction, but
9 we think we need to be measured in our expenditures towards
10 the retail side of things until we know a little bit more.
11 I would be happy to take any questions.

12 MS. BAROODY: Thanks, Rob. Go ahead.

13 MR. MUENCH: Rob, thanks for being here today.
14 You may have touched on some of these issues already, but
15 let me ask the \$64,000 question, within the next three to
16 five years, how can we assure that private partners and
17 investment are present to back-out the need for continuing
18 public funding, which is becoming increasingly untenable and
19 politically unsustainable?

20 MR. ELAM: For hydrogen, specifically?

21 MR. MUENCH: Yes. What is your take on that?

22 MR. ELAM: That is a good question. You know, I
23 mean, I think we need to see -- and let's clear the
24 definition between when you say private funding -- there is
25 the sort of investment capital side of things, and then

1 there are the investments made by the companies that are in
2 the industries themselves, towards the objectives. You
3 know, I think that, as we know more, as we have more data
4 points towards the true costs, and begin to see real
5 progress towards lowering those costs, and towards the
6 efficiencies of scale, the private sector will begin to look
7 again at the opportunities. Believe me, if the opportunity
8 is real, aggressive investors will begin to put money into
9 the sector. The challenge is what metrics do they need to
10 see to believe it is real, and how do we show them with
11 credibility those business models? And I think we just need
12 some time to collect the data to be able to do that.

13 MR. MUENCH: Thank you.

14 MR. OLSON: So, Rob, just to kind of follow-up a
15 little bit on that, one of the -- we want to explore this in
16 a lot of ways, and we appreciate your just willingness to be
17 here to talk about this. Part of the thing we are finding
18 is, if government is funding 90, 80, 70 percent of all
19 infrastructure, and then including operating costs, which
20 can be every year pretty significant, and the cost of the
21 systems for kind of permanent retail could be approaching
22 \$3, \$4, or \$5 million per site, are there any things that we
23 should explore from your view that might be -- well, I guess
24 the goal for us as government, how do we get this to the
25 point where, like we are with other fueling infrastructure,

1 covering a 50/50 type of investment what for the most part
2 is one percent of the marketplace right now; we hope that
3 expands. And so we have heard some things today, for
4 example, little hints of things that fuel through-put may be
5 a factor in this, that if you can boost this station from 25
6 kilograms a day to 500, 400, and then we are hearing some
7 that it could be close to 1,000 in terms of users, and also
8 keeping in mind that some of the users are going to be -- I
9 am not saying that this is particularly one specific site,
10 but some of the users are going to be medium duty buses,
11 transit, trucks, others are going to be passenger vehicles,
12 is there anything in that area that could offset some of the
13 risks, if you can get more concentrated through-put, and
14 these cluster kind of options?

15 MR. ELAM: Yeah, I think absolutely. I mean, I
16 think it makes sense -- today you see the successful
17 projects as far as through-put are primarily based around a
18 fleet usage environment where the vehicles can be procured
19 by a single source. Generally they are oriented as far as
20 their traveling around, you know, to a base of operations,
21 so for filling -- I think that has come up a couple of times
22 today, as a sort of public-private, maybe half in the fence,
23 half out of the fence, the question that has a good solution
24 from a cost-share perspective, the question that is in there
25 is how many of those locations are ideal for public access.

1 And then that is where it becomes more problematic because,
2 generally, vehicle storage bases are not in public locations
3 by design, so I think we could look at the opportunities
4 around that and it sounds like there are a couple of
5 opportunities on the table in California that would make
6 sense for that type of an initiative.

7 MR. OLSON: And are there options that, from your
8 view, can other fuels that you might sell in a fueling
9 station, can that carry the lesser volume of hydrogen that
10 might occur?

11 MR. ELAM: Right, as a sort of portfolio of fuels
12 from a single site. I think it would be difficult. Every
13 one of these fuels, even the most well established, still
14 have serious economic challenges. To ask something like
15 even E85 ethanol to bear the cost of hydrogen on a site, I
16 do not think would be -- it would be very difficult to make
17 that economic argument. I mean, it is clear that even fuels
18 like biodiesel and ethanol which have relatively large
19 embedded vehicle numbers compared to something like a fuel
20 cell vehicle are barely getting over starting to see a path
21 forward to be profitable and have a viable economic model.
22 So it would be difficult to pull those margins backwards to
23 support hydrogen on a site. You could get efficiencies
24 potentially on OEM, get efficiencies on real estate cost,
25 you could have some efficiencies around marketing, but the

1 actual cost of the equipment the number of vehicles, the
2 cost of hydrogen of the fuel itself would be unaffected by
3 the efficiencies that you could potentially gain by a sort
4 of platform approach to a retail station, although we are
5 certainly working very hard at understanding how we could --
6 how those numbers could benefit hydrogen. We just simply do
7 not have enough data at this point to be able to make a
8 strong economic case. And, as we all know, in this day and
9 age, making a strong economic case is critical. People are
10 very risk adverse right now in the capital markets.

11 MR. OLSON: And another kind of question, similar
12 line of thinking here is, to your knowledge, is there an
13 advantage if hydrogen is available at a cheaper price than
14 gasoline, diesel, other fuels, is there anything there that
15 can offset some of the risk?

16 MR. ELAM: Potentially. It is interesting, I
17 mean, I think the research that we have seen in the data
18 points there are around cars that are flexible fuel by
19 nature. So if someone has a choice to put a petroleum
20 product in, or has a lower cost, you know, of gasoline
21 versus ethanol, biodiesel versus diesel, but there is a
22 choice and they can always switch back, when someone
23 purchases a hydrogen vehicle, they cannot put any other fuel
24 in there, so price needs to be a driver in the purchase
25 decision, but then they are essentially stuck, right, with

1 whatever the pricing scenario might be. So I am not sure
2 how reducing that price when they make the purchase
3 decision, I am sure they would want to see some
4 predictability of what their fuel costs would be going
5 forward because you would really be stuck then, right, if
6 you had a hydrogen car and the prices went through the roof.
7 So you would want to have some sort of predictability, I
8 would guess, but I do not know if dropping it 20 percent
9 would help. And I am not sure ultimately for a retailer
10 that margin is even visible at this point, you know, to be
11 able to see where those positive -- potentially positive
12 economics could come.

13 MR. OLSON: And we are aware that you have a
14 relationship with Shell for your E85 islands, and both Shell
15 and Chevron have had an interest in this hydrogen in the
16 past. If they have a renewed interest in this area, and
17 they could offset some of the risk, would you be a partner
18 with them? Would you consider a similar kind of partnership
19 like you have with the other fuels?

20 MR. ELAM: Absolutely. I would not want to speak
21 for the hydrogen industry, but I think we are all looking at
22 any productive partnerships, any and all productive
23 partnerships should be on the table.

24 MR. OLSON: Very good. Thanks for your comments.

25 MR. ELAM: Thanks, Tim.

1 MS. BAROODY: Thanks, Rob. Okay, next up with
2 Linde, Michael Beckman.

3 MR. BECKMAN: Okay, thank you. Yeah, my name is
4 Mike Beckman and I am with Linde. I run our western region
5 and, as such, a lot of the alternative fuels activity goes
6 on in California, which is what I manage. So I am going to
7 talk a little bit today about the infrastructure and what
8 Linde is trying to do. I first have to say, it is exciting
9 to hear a lot of the enthusiasm in the room from the
10 speakers previous to me, that talk about what they are doing
11 from an OEM side, with the number of cars that are going to
12 be out there in the future, and the money that is being
13 spent on R&D to deploy those cars, as well as other
14 infrastructure suppliers, and that is going to help the
15 industry overall, so we are all for that.

16 My first slide is, I am not going to go into too
17 much here, you know, from our perspective, we look at the
18 competing technologies and we are obviously in a lot of
19 different alternative fuels, we have got an LNG plant that
20 we are bringing under commercialization, and some other
21 areas. Hydrogen is one of those, and as hydrogen competes
22 against other technologies in the automotive industry, you
23 know, we see this as a clear winner down the road. You have
24 heard these things before around comparing electric drive
25 vehicles, and battery electrics, you know, today it is

1 pretty clear that the long range goals are going to be met
2 with hydrogen, I think that is just really what I want to
3 say here. Batteries weigh more, take up more space, more
4 greenhouse gas production, especially when you look at the
5 current mix of our grid today with electricity, and of
6 course, the cost is more. So we see this as a winner and we
7 are here to support the infrastructure, and we are doing a
8 lot of exciting things around that. I will mention some of
9 those things here today.

10 You know, we see advances in infrastructure as the
11 way to commercialization here, and I think it is fair to say
12 that there are some things that will help us along that
13 path, I will talk about those here. We have made some
14 advances around commercial technology that meets the retail
15 expectations here, and when we say fueling is one of those,
16 you know, I think what we have seen in the past in our
17 industry is, whether it is here in the U.S. or in Europe, or
18 other places overseas, is that the initial stations were
19 kind of exploratory demonstration stations that, while they
20 have got hydrogen in the tank, they did not do so in a quick
21 manner that really met retail expectations. And I think
22 that, going forward, what Linde is trying to focus on is
23 really release aid and above. And release aid kind of
24 standard is 5 kilograms in three minutes, the ability to
25 fuel multiple cars in succession, and up to four or five

1 cars in an hour. And, really, yes, the initial stream of
2 cars when you have five cars fueling at a station in Irvine,
3 it is okay to maybe wait behind one car. When we start
4 ramping up and have 10 and 20 and 30 cars trying to fuel at
5 one station, and even more, 100, it is going to be pretty
6 upsetting to the consumer to be able to stand in line and
7 wait for 25 minutes to fuel their vehicle. So we are trying
8 to address that problem with some of our technology, and we
9 have got stations out there today deployed in Germany and
10 elsewhere, that are already meeting that standard.

11 Any kind of technology like this in an
12 infrastructure roll-out obviously, you know, Tim is talking
13 a lot about cost, well, how do you get that cost down? You
14 know, clearly there has got to be incremental change in our
15 efficiency, in our cost to provide the components necessary
16 to do the infrastructure, but then also there is typically
17 step change in when there is roll-outs of this type of
18 technology, and we think that within Linde we have got a
19 step change technology called ionic fueling, or ionic
20 compression technology, which is really our next step. Now,
21 we are doing this already with forklift truck fueling, and
22 David mentioned that with the plug power, and we see this
23 coming with automotive and bus fueling, and so forth, down
24 the road, too. And, really, this technology is all about
25 making it more cost effective, reducing costs, both O&M

1 costs, and operational costs, and maintenance cost. And,
2 you know, the ionic compression technology is volumetrically
3 efficient, isothermal compression, contamination-free, it
4 really helps us achieve the conversion of electrical energy
5 into power, into compression, gas tight system, we really
6 think this is going to help us kind of get that next step.
7 Now, we are not there today with cars, and that is going to
8 take a little bit of time. We need to deploy the existing
9 systems today that are in commercial operation, and then get
10 to this point.

11 I will give you an indication of what that means.
12 Again, kind of focusing on the cost piece, you know, we see
13 today indicative cost reductions in these areas, just with
14 our first systems, of around 30 percent total. So you can
15 see kind of the different cost components there from a
16 capital standpoint up top, you know, through the OpEx and
17 then maintenance pieces, and each of those are significantly
18 reduced with this type of technology. We want to make it
19 bigger, we want to make it cheaper, and this is going to
20 help us to get there.

21 You know, this is the standard business school
22 graph of more cars helps it make it more efficient, you
23 know, you have got really the name of the game is we have to
24 be able to spread our technology, spread that infrastructure
25 cost over more vehicles. Today we are looking at, you know,

1 five, ten vehicles per station, in the future we have got
2 to look at 100 to 200 vehicles per station. Clearly, the
3 costs will come down significantly in that alone, but also,
4 as we deploy more of these stations, the components will
5 become cheaper, we will achieve economies of scale with more
6 mass production, we buy in bulk some of the key components
7 such as the compression, the storage, and so forth, and that
8 helps drive cost down overall. Clearly, that is where we
9 want to get to. Now, today, obviously we are not there. To
10 be able to get to that point, as a big industrial company
11 with multiple avenues to invest in, we are not going to take
12 that investment on loan and we need government support to be
13 able to do that, as I think you have heard here from others.

14 As you look at kind of how these are deployed into
15 the future, you know, one of the issues is that, as you move
16 into -- you take Dr. Tim's presentation around Irvine, and
17 he talked about putting five or eight stations to cover all
18 the City of Irvine, well, that is fantastic, but the problem
19 with that is that you have to put 100 kilograms a day
20 station in, again, that is going to serve two or three cars.
21 So how can we as an industry, as infrastructure providers,
22 how can we do that more efficiently? And so, at Linde, we
23 are looking at ways to get the stations in more cost-
24 effectively, time to go to the next slide with this, we are
25 looking at -- well, let me back up a second -- there are

1 some things we can do to help kind of address that problem,
2 and I will talk about a couple of those. The first and
3 foremost, again, is quicker ramp-up of cars, and I think the
4 boys from the automotive companies are going to be able to
5 do that, as they talked about today. But the next thing
6 that we are looking at doing is making modular designs. So
7 if we can -- and scalable designs -- if we can deploy
8 stations that are easy to put in, so kind of a station-in-a-
9 box concept, which is really what our San Francisco Airport,
10 our initial station that is going in, is going to be, very
11 easy to deploy, so it reduces the infrastructure cost and
12 the time to install it, but then we make it so that we can
13 add additional storage, upgrade the pre-cooling so that we
14 can take a station that serves, say, 100 cars a day, or 50
15 cars a day, and very quickly and easily, as those cars ramp
16 up and the demand ramps up, be able to adjust to that. So
17 that is one thing that we can do, and we are looking at
18 being able to do that. We also want to make stations that,
19 again, can be easily deployed, but then easily redeployed.
20 So you take a station that is perhaps suitable for 50 or 100
21 cars, as that demand ramps up in a certain area, we will
22 redeploy that station to another area, and put a larger
23 station in. We want to be able to do that cost-effectively
24 and, again, this has kind of been our approach and our
25 thinking along these lines.

1 I guess, kind of in closing here, yes, we want to
2 deploy these stations. We need government support to do
3 that. We still have some challenges to overcome, and Alex
4 with GM kind of mentioned one of those, which does not get
5 talked about a lot, but we have got some significant issues
6 around permitting, for instance. You know, you talk to
7 anyone who has put in stations today, or is in the process
8 of putting stations in, and that is a laborious process
9 that, frankly, the cost going into that as we model this are
10 somewhat unknown. It can add tens or even fifty --
11 thousands of dollars to the station deployment and it
12 extends the time to deploy by months, if not longer. That
13 is one area where I think government can assist. Again,
14 these are areas that can be overcome. The Codes and
15 Standards piece, and commonality around that, a lot of work
16 being done there, that is also an area that can be worked
17 on. You know, we see that over the next several years, with
18 additional station deployments, with us, as well as other
19 infrastructure providers, we are going to continue to
20 improve that efficiency and the cost will come down, but,
21 again, initially government support is going to be needed
22 for the next several years at the same levels we see today.
23 So any questions?

24 MR. MUENCH: Tobias Muench, Energy Commission
25 staff. Essentially, you have touched on some of this, but I

1 would like to ask you the same question that I asked
2 before, and I am going to repeat it. Within the next three
3 to five years, how can we make sure that private partners
4 and investment are present to back-out the need for
5 continued public funding which is becoming increasingly
6 untenable and politically unsustainable?

7 MR. BECKMAN: Yeah, I guess the first thing you
8 could do is increase the price of gasoline significantly.
9 You know, all kidding aside, we look at this in Europe and
10 they pay four times more for a gallon of gasoline. The
11 hurdle rate to overcome that, obviously a lot of that is
12 government taxes and so forth, but the hurdle rate to
13 overcome there is significantly lower. And the expectation
14 from the consumer is that they pay more for an equivalent
15 gallon to go 100 miles. I mean, that is one of the first
16 things that we could do. I heard it from, I think, Jim Boyd
17 at one of the conferences I was at a few months ago, who
18 talked about -- it might not have been him -- but somebody
19 was talking about putting a ceiling or an artificial floor
20 on the price of gasoline through taxes to support some of
21 the alternative fuel investment. That is one thing the
22 government could do. You know, gasoline is going to go up,
23 our efficiency is going to increase as we deploy more
24 stations. You know, we have deployed only a handful of
25 stations in the States. I mean, to be fair, we have got to

1 deploy 10, 20, you know, 50 stations before that becomes
2 significantly down to a point where it is commercial and
3 stand alone. That is not to say that the CEC or California
4 should bear the burden of investing at the same levels they
5 do today, that burden, we would expect, would come down as
6 we pick up more of that. Again, this is going to come with
7 additional deployments, though.

8 MR. MUENCH: Thank you.

9 MR. OLSON: Mike, I wanted to ask a question about
10 your manufacturing here, and maybe I should have described
11 this earlier, it is part of our program of opportunity
12 solicitations we will be putting out soon and one
13 significant initiative will be a kind of expansion,
14 retention, recruitment of manufacturers primarily on
15 electric drive, but it really could be across the board on
16 any fuel technology. And the nature of that would be -- it
17 is a job creation, job sustaining type of activity. We are
18 willing to put money into expanding your ability to increase
19 manufacturing, component parts, batteries, whole vehicles,
20 systems, and so part of that is it has got to be in
21 California, and we want -- if any of you are interested in
22 this, we definitely want to talk to you about this process.
23 And I guess that is it. Are you planning anything here that
24 is either assembling or manufacturing of any of the
25 component parts or whole systems?

1 MR. BECKMAN: Yeah, so certainly there will be
2 some assembly here in California, I mean from a jobs
3 perspective. Every time we deploy a station, obviously
4 there will be infrastructure jobs that will be created
5 because of that. We have got operation and maintenance
6 personnel that, as we build out our capacity to be able to
7 service these stations and deploy them on a wider scale,
8 clearly we will drive what we would see a green jobs
9 associated with those deployments and the upkeep and
10 maintenance of those stations. We have got partners in the
11 states, perhaps not in California, that we work with to
12 Americanize these stations and to build some of the
13 components and to assemble them, so that is where we are at
14 right now, and we are continuing to look for additional, I
15 guess, U.S. grown infrastructure and deployment.

16 MR. OLSON: Another question I have is, is there
17 any issue at this point on the kind of standardization, if
18 you want to call it that, the 350 bar, 700 bar option, so we
19 know, for example, Honda, their Clarity is really designed
20 for 350 bar pressure. From your view as a fuel supplier,
21 any issue there that is unsolvable?

22 MR. BECKMAN: No. Absolutely not. I mean, you
23 know, certainly there is a little bit more cost associated
24 with higher pressure, I mean, I guess that is common sense,
25 but we think that with the technology that we have, that

1 cost is not that significant, and our approach is to design
2 stations that would meet multiple technologies and meet the
3 needs of multiple OEM's as they design their cars, fuel cell
4 vehicles. And so, from our standpoint, no, I mean, we are
5 going to adapt to what the industry needs, and we do not see
6 any insurmountable hurdles there, nor do we see that as a
7 gigantic cost adder.

8 MR. OLSON: Okay. Thanks a lot.

9 MR. BECKMAN: Thank you.

10 MR. BAROODY: Thanks, Michael, for your
11 presentation.

12 MR. MUENCH: I have another short one. I am
13 sorry. Can you say a few words to Linde's involvement and
14 philosophy ideas about renewable --

15 MR. BECKMAN: Yeah, I mean, so from our
16 standpoint, obviously that is the Holy Grail -- how do you
17 get renewable production? And we are looking at some
18 methods to be able to do that today, nothing I could speak
19 of specifically, but we are exploring that area and we have
20 had those discussions. You know, there are some obvious
21 paths that are out there, there are some economic issues
22 with those today, you know, things that we think can be
23 solved. If you stand back a second and look at when these
24 hydrogen production -- we have got one of the only plants in
25 the world that really is a renewable hydrogen plant today in

1 our Magog Plant in Canada, which is a byproduct from a
2 sodium chloride production, and is driven by a majority of
3 hydroelectric power up in Canada. So we are already kind of
4 meeting a need. Now, it is not recognized as such by the
5 GREET modeling, we would like it to be, but the fact is that
6 that is really green hydrogen today. So we are looking at
7 other opportunities like that, as well.

8 MR. MUENCH: Thanks much.

9 MS. BARODY: Thank you. Okay, Airproducts, Ed
10 Heydom.

11 MR. HEYDOM: Thank you, everyone. I am pleased to
12 be here to talk about Airproducts' perspective regarding
13 hydrogen infrastructure and the impact on the planning going
14 forward regarding the investment development for AB 118.

15 Just a quick overview of Airproducts. We are the
16 largest merchant supplier of hydrogen in the world. We
17 produce about 2 billion cubic feet per day, worldwide. We
18 have been involved in over 100 hydrogen energy projects
19 since 1993 with stations around the world, but with a strong
20 focus in California. We have talked a bit today about --
21 and there have been references -- to low cost ways to
22 produce hydrogen, and how do you get there. And as some of
23 the speakers have mentioned, there are already ways today to
24 produce hydrogen at the point of use at low cost, at
25 attractive cost for use in transportation fuels. And most

1 of those focus on central production -- large facilities,
2 economies of scale, again, just some of the points that
3 previous speakers have mentioned. The challenge is, how do
4 you get that low cost molecule to the point of use? One low
5 cost way that has been mentioned is by pipeline, where those
6 assets make sense based on the volumes that are being
7 distributed. But hydrogen can also be distributed by truck,
8 either as a liquid or bulk, and there is also some specific
9 hydrogen fueling products that we have developed to meet the
10 emerging fueling market. We have also looked at distributed
11 hydrogen production from a variety of sources and there are
12 opportunities worldwide where that would also make sense for
13 hydrogen.

14 But what we have been focusing on in the past few
15 years is looking at ways to look at delivery systems for
16 hydrogen, getting it to vehicle fueling. We have done work
17 back in the early part of this decade, looking at on-site
18 reforming, we have looked at electrolysis, we have looked at
19 other modes, and now we are looking at trying to get some
20 learning on some other means of providing hydrogen. Tim
21 mentioned the UCI station, which Airproducts provided under
22 a DOE program, and that is supply by liquid delivery system.
23 We are developing a station off of the existing hydrogen
24 pipeline in Torrance with Shell Hydrogen, looking again as a
25 means to try to provide that low cost molecule into a

1 refueling station environment, trying to get that learning
2 as to how you do that and what ways you could scale that up.
3 And then something called "pipeline delivered," which is the
4 station that ARB funded, what we call South Torrance or
5 Harbor City, looking at ways to move the molecule from that
6 low cost point of production into a retail gasoline
7 environment.

8 So those are some examples of trying to take
9 advantage of existing assets. We are also, as Tim
10 mentioned, the lead in developing the project with ARB and
11 DOE at Fountain Valley, California, Orange County Sanitation
12 District, which is the incorporation of the high temperature
13 fuel cell coproducing electricity, hydrogen, and heat, and
14 that system is going through shop testing at the fuel cell
15 provider's location, Fuel Cell Energy in Danbury,
16 Connecticut, and then we will be bringing that online next
17 year.

18 Now, people have mentioned why hydrogen, and this
19 is just our view of the benefit on a well to wheels basis,
20 that hydrogen, as you look at all modes of production,
21 distribution, is going to be the clear winner from an
22 environmental basis. It also has the advantages of
23 sustainability with respect to other fuels.

24 What I thought I would do today, to talk about --
25 since you have the challenge of coming up with a plan going

1 forward for the funding through AB 118, is to first take a
2 look back at some of the earlier programs that have
3 happened, and to try to glean some lessons learned out of
4 those activities. And what we have seen is that, in a lot
5 of stations, most of the station capacities exceeded the
6 early vehicle demand, which made sense because, you know,
7 they were normally designed for one or two cars at the
8 outset, and just doing some economics of the deployment of
9 those stations, those stations were oversized. So in any of
10 the programs, you have to think about underutilized assets
11 that you measure as you go forward, I think.

12 As I mentioned, we looked at multiple options for
13 production and delivery, as some of the other participants
14 say in the DOE Tech Validation Program. Now, some of those
15 we probably should be looking to eliminate just because of
16 cost and scalability, as we have talked about today, you
17 know, the key to get to is what the future is, and how
18 quickly you can get there. And our engineering folks have
19 told us that some of the smaller station configurations, you
20 can end up with over 19,000 different configurations. We
21 are all driven by productization and coming up with a
22 standard approach. So as you go to larger stations, lower
23 cost solutions, you are probably going to get down to those
24 fewer options, and the key is to try to get to that as
25 quickly as possible. And what we have seen is that the low

1 cost production methods at the existing facilities and can
2 be used today for the transportation market, and for a
3 funding agency, that means minimizing additional funding
4 based on taking advantage of existing capacity within the
5 systems where they exist, and they do exist in California.
6 And the key is really the supply chain. How do you get it
7 from that point of use where it is used in industrial
8 applications into the retail fueling market.

9 Now, renewable sources, as I mentioned, our
10 project at Fountain Valley, that is one aspect that we are
11 looking at, but those need to be also developed. As Mike
12 mentioned, there is probably some cost impact compared to
13 conventional steam methane reforming in the early years, and
14 then you have to also figure out how to move those molecules
15 if they cannot be dispensed at the point of production.

16 So the first thing I would say is focus, stay
17 focused on what the objectives are moving forward. You have
18 heard talk from the OEM's and the other suppliers today that
19 critical mass is important, both on the vehicle side and the
20 station side, we support the cluster concept and the work
21 that California Fuel Cell Partnership did with regards to
22 the Action Plan, it is a good step and it has helped, I
23 think, all of us to be able to understand the plans for
24 roll-out of vehicles, maybe not the specific numbers, but
25 also to understand how those vehicles can become just in

1 terms of production techniques on the vehicle side. So
2 critical mass is going to be a key component. And then
3 target the geography, and Southern California, as everyone
4 has said today, makes a lot of sense for a key geography,
5 although there are opportunities in other parts of the
6 states, in other parts of California, depending on the
7 vehicle deployment plants. Obviously, SB 1505 has to be
8 considered as a key component of this.

9 We like the opportunities to try to deploy at
10 retail gas stations because of the ability to gain customer
11 acceptance more quickly. If there are opportunities to come
12 up with stations, the dual use facilities, certainly that
13 makes sense. But in the dialogue I have with the OEM's and
14 the feedback they get from their users, you clearly hear
15 that the retail fueling environment is what people are
16 looking for. So we have to continue to drive to overcome
17 the hurdles that Rob mentioned earlier today.

18 You have to install sufficient stations in order
19 to make the step change that Tim and Mike had mentioned
20 earlier. You should look for opportunities, again, as Mike
21 mentioned, for mobile stations, to get some of the economies
22 of scale and to get the infrastructure out all at once, and
23 to continue to look for opportunities to develop those
24 relationships and the installation of those stations.

25 You need to manage capital infusion at the station

1 operator. Good thing I was not working on this when Rob
2 was giving his remarks, but that is clearly a component, is
3 the risk management for the station operator because, at the
4 end of the day, they have the largest at least public
5 exposure and potential for financial exposure if stations
6 are under-utilized.

7 Infrastructure should really meet some key
8 criteria. It needs to be scalable so you can go from the
9 low volume periods during this 2010 to 2015 timeframe up to
10 when there is full deployment. The infrastructure should
11 look to minimize that site investment at the point of use.
12 It should consider systems that provide value today for
13 applications maybe beyond traditional light duty vehicle
14 fueling. That way, if there are delays in the market, or if
15 there is, depending on the roll-out time for vehicles, there
16 are opportunities to redeploy those assets, so it minimizes
17 the idle asset capital for all of the funding participants.

18 And then, obviously, the program has to think
19 about going forward when there are tens of thousands of
20 vehicles in the 2015 to 2017 timeframe -- station sizes, you
21 know, 500 to 1,000 kilograms a day are probably sustainable
22 from the business case standpoint, and that will be the time
23 as we move away from the government incentives during the
24 early deployment period, and more into a standard business
25 case when we start looking for tax incentives and other ways

1 to continue to sustain the industry. But I think that is
2 key, to look at those opportunities where it is not the time
3 to deploy very small stations that have no opportunities for
4 growth if we are going to meet the demand requirements that
5 the OEM's have talked to us about today. We need to be
6 looking at ways to get to those large stations very quickly,
7 otherwise, when the tens of thousands of vehicles arrive, it
8 will be a challenge for the infrastructure providers to be
9 able to provide that on an ongoing basis.

10 So those are my remarks. I tried within those to
11 answer the questions that were included within the packet
12 that was sent out. So I look forward to questions, and
13 thank you for your attention.

14 MS. BAROODY: Thank you, Ed. Any questions?

15 MR. OLSON: Yeah, this is Tim Olson.

16 MR. HEYDOM: Hi, Tim.

17 MR. OLSON: So, when you kind of look across the
18 development stream of this of this, is there -- what is the
19 best point where you are going to get cost reduction, cost
20 break? It is probably not going to be in vehicles,
21 infrastructure we have heard here today that there are a lot
22 of challenges there; what about on the fuel? Is there a
23 chance that you are going to have -- that you can produce
24 hydrogen that is going to be cheaper than other fuels?

25 MR. HEYDOM: I think there was talk today about,

1 given the price spread today between natural gas and
2 petroleum fuels, that on a per -- we will call it on a per
3 mile or per kilometer use within the vehicle, that hydrogen
4 is made today that can support vehicle infrastructure at an
5 equivalent cost per kilometer compared to gasoline. So the
6 question is really scale, and how you get it to the point of
7 use. So there is no real surprise as to how to do that,
8 what we have to do is incorporate the renewable component
9 into our hydrogen production infrastructure going forward
10 and obviously we have that requirement in California, and we
11 will be looking to meet those requirements, both for State
12 requirements and also specific to SB 1505. So we are not at
13 the point -- I think most of it is now -- any of the cost
14 issues are, again, small stations that have high unit costs
15 for components such as maintenance, delivery, items that, if
16 you look at gasoline stations, those items get blended out
17 in most, you know, when I am at my local station, there are
18 always dozens of cars that are filling up, so those costs
19 can get merged in, so you are looking at technologies that
20 can come to that low cost, but also getting enough volume to
21 be able to spread those costs out across a number of users.

22 MR. OLSON: And can you just elaborate a little
23 more about the SB 1505? Can you produce renewable hydrogen
24 today and at a price where you can sell it?

25 MR. HEYDOM: Yes.

1 MR. OLSON: That would be from your pipeline
2 stream or other --

3 MR. HEYDOM: Well, we are evaluating from all
4 points of production -- again, because part of it is supply
5 chain, at both the point of production, and then the final
6 point of use. So you cannot just look at it at one
7 location, at the specific point. The pipeline has obvious
8 advantages because of the scale of the system, but we are
9 looking at renewable hydrogen at various locations in order
10 to serve different markets. And, again, the total cost will
11 be the sum of that cost of production, cost of distribution,
12 and the cost of dispensing.

13 MR. OLSON: And that feedstock, is that feedstock
14 biomethane?

15 MR. ELAM: It can be. That could be something
16 that --

17 MR. OLSON: Or wastewater treatment?

18 MR. ELAM: It could be. The wastewater treatment
19 concept through the multi-carb fuel subsystem, that is part
20 of the ARB project, the ARB DOE project that we are
21 evaluating, and to see how that would fit into a supply of
22 hydrogen on a renewable basis.

23 MR. OLSON: Can you make that in sufficient
24 quantities to match the roll-out of vehicles?

25 MR. ELAM: That is part of the key is to be able

1 to obviously get to scale. That system at Fountain Valley
2 is sized for 11 kilograms a day. Again, that is really just
3 the demonstration of the technology. Clearly, going to
4 greater scale is better from the power production side of
5 that system, and the power economics still have to work on
6 those and still -- and electricity generator by nature that
7 co-produces hydrogen, it is not a hydrogen system that also
8 makes electricity. So you need to have the right mix of
9 power costs and hydrogen pricing. But clearly, scale on the
10 fuel cell makes sense and scale on the hydrogen side would
11 also make sense. But I think we are looking at systems --
12 fuel cell energy has a fuel cell product that produces
13 nominally 2.8 Megawatts, so part of our evaluation is
14 looking at co-production of hydrogen off of systems of that
15 scale, so that would be over a ton a day of hydrogen,
16 easily.

17 MR. OLSON: Very good. Thank you.

18 MR. WARD: I have a question. Regarding the --
19 you mentioned scalable several times in your presentation
20 and I am wondering, under the present definition of 1505,
21 you are not making that renewable hydrogen, there still
22 would be requiring a regulatory fix there to make it more
23 energy logical?

24 MR. HEYDOM: That is a loaded question. No, I
25 will answer a different question than try to answer that

1 one. We are looking at the broader application of energy
2 and what is the best use of renewable sources, so when there
3 are opportunities where it makes sense to produce hydrogen,
4 then that is the right thing to do, and that is the type of
5 project that we are looking to participate in. If there is
6 better uses for that renewable component, or if there are
7 other needs for it, then obviously we are competing against
8 that, but I think that is my answer so far.

9 MR. WARD: Would you suggest a clearer path to
10 renewable hydrogen than the one presently contemplated under
11 1505?

12 MR. HEYDOM: I think the current definition of
13 1505, as I understand it, could use some clarification based
14 on the lack of early acknowledgement of other sources of
15 renewable hydrogen, for example, the anaerobic digester gas
16 produced from wastewater treatment was not originally
17 envisioned as a renewable component within the statute. So
18 I would think that some analysis of that, looking at
19 available feedstocks that could produce hydrogen, and what
20 their evaluation is under GREET or similar models, I think,
21 would make a lot of sense.

22 MR. WARD: I think we agree because I think the
23 intent is something we can all universally agree on, but how
24 it was actually formatted might be the challenge. You also
25 mentioned scalability, getting to stations that could be 500

1 to 1,000 kilograms a day. Is that a potential for the
2 stations we build now, could be modularly scalable to get to
3 that point, so we would not have to go through the
4 permitting repetitively?

5 MR. HEYDOM: Well, part of that, I think, is you
6 would take the strategy, if you could develop a site that is
7 amenable to a larger station, you would go ahead and permit
8 it on that basis. One of the challenges with hydrogen,
9 especially in Southern California, is footprint, is how much
10 hydrogen can you -- how much equipment can you fit given all
11 the setback requirements within the NFPA requirements? So
12 you have to look at the different sites and say, "How much
13 infrastructure can I put in at that location?" I would then
14 go ahead and try to permit for that maximum value if that is
15 of interest to the station operator, so you would not have
16 to go back and repeat the process.

17 MR. WARD: Not necessarily build to that maximum,
18 but go ahead and permit to it? Is that --

19 MR. HEYDOM: It depends on the site. It depends
20 on how you choose to get to that larger capacity. We worked
21 on projects where we have done it on a modular approach, a
22 stepping stone approach, for example, the UCI station, that
23 way where we started at 25 kilograms per day because of the
24 original intent of the station. Now, there is clearly
25 enough demand in the area to look to increase that, so

1 opportunities that UCI is trying to develop to increase the
2 capacity of the station, we think, makes a lot of sense
3 based on the demand at the station. And there are other
4 locations that look at it that way. I think there is merit
5 to limit the capital investment at the start, but you also
6 have to be able to anticipate the growth and how quickly
7 that growth is going to come.

8 MR. WARD: Okay, that is what I am getting at,
9 trying to find the sweet spot between those two issues.

10 MR. HEYDOM: As you look at the slope of the
11 curves for the deployment and the action plan, it is going
12 to come very quickly, and that is why the graph that Tim and
13 Mike showed, that shows that stepping forward approach, and
14 I think the presentation by Todd Sukow this morning on what
15 they are doing in Korea is the same thing, it is showing
16 that pre-investment on stations to be able to anticipate a
17 rapid growth of vehicles. I think you have to be able to
18 look at sites that can do that and look at technologies that
19 can be rapidly deployed and modified to be able to meet that
20 growth.

21 MR. WARD: Thank you, Ed.

22 MS. BARODY: Thanks, Ed, for your presentation
23 and answering all those questions.

24 MR. HEYDOM: Thank you.

25 MR. MUENCH: One more, please. May I ask you the

1 same question? Within the next three to five years, how
2 can we assure the private partners and investment are
3 present to back-out the need for continuing public funding,
4 which is becoming increasingly untenable and politically
5 unsustainable?

6 MR. HEYDOM: Okay, I was thinking of an answer
7 when you asked it to the other speakers. You know, the key
8 really is, as the others have said, is to get to that market
9 driven approach, to get to the right station size, and
10 potentially looking at maybe a sliding scale of government
11 support. This early round of funding where you need a lot
12 of geographic coverage without a lot of through-put, you
13 probably end up with the potential for a larger government
14 participation, but as usage goes up over time, there is no
15 reason for the government participation to continue at that
16 basis, and once you get to the point where you are deploying
17 stations in that sweet spot, if it is 500 or so, or 1,000 or
18 so kilograms a day, where for station operators, you point,
19 it makes sense to go ahead and make that investment on their
20 own, they you get the answer automatically. So I think
21 having the foresight to do the pre-investment with the
22 strategy of being able to quickly add capacity to those
23 stations, but knowing once you have added the capacity that
24 you have a way to back out of the funding, I think, makes
25 the most sense from my perspective.

1 MR. MUENCH: Thanks.

2 MS. BARODY: Thank you, Ed.

3 MR. HEYDOM: You are welcome.

4 MS. BARODY: Okay, we have one more speaker in
5 this panel, Hydrogenics, Kevin Harris. Mark Schiller is not
6 here today, so we will end with Kevin and then we will go to
7 Public Comment.

8 MR. HARRIS: Thank you. First of all, thank you
9 very much for inviting me to this panel, and thank you to
10 the audience members here and online for being diehards. I
11 will try to go through this as fast as I can, but basically
12 today I am going to be talking about electrolytic hydrogen
13 and how we can tie in production of hydrogen via
14 electrolysis and also enable renewable energy to be a more,
15 larger factor in the grid.

16 So just a little bit about Hydrogenics. The
17 bullets are a little bit off, but hopefully we will be okay.
18 We are based out of Canada in Toronto. We have facilities
19 in Belgium and in Germany. There is also an office in
20 California. We make electrolyzers and protonic exchange
21 membrane fuel cells. We have over 1,700 hydrogen products
22 out there and we have been doing that since 1948.

23 Just to show you some of the refueling stations
24 that we have been involved with, many around the world, but
25 several in California. The picture there of the Santa

1 Monica station at the top, and the Oakland station at the
2 bottom. This just shows you a picture, if you are curious
3 to know what our products look like, the one on the left is
4 our 130 kilogram per day hydrogen production unit,
5 electrolyzer, and then the other units are fuel cell, either
6 for back-up power, or for mobility power such as buses or
7 trucks.

8 So one of the first things I wanted to mention is
9 that, for all intents and purposes, I am -- we are -- for
10 hydrogen and against nothing, and what I mean by that is,
11 you know, there is going to have to be a myriad of solutions
12 to solve the climate change issues that we have here, and
13 we, in fact, believe that there is a great marriage between
14 the two technologies of batteries and electricity, and
15 hydrogen and fuel cells. And we, in fact, endorse the
16 battery dominant, smaller fuel cell plug-in hybrid power
17 train architecture. And two examples are shown here, one is
18 a bus that is currently operating in Columbia, South
19 Carolina, which is a 32-Kilowatt fuel cell, and then also we
20 heard Lawrence Weisdorn talk from Vision Industries, his
21 truck also contains our fuel cells, but it has a battery
22 dominant type of architecture. And I can get more into that
23 later, but today I will be talking mostly about our
24 electrolyzer products.

25 Okay, one of the main things I want to convey to

1 you is that hydrogen is an energy storage medium, but it is
2 also an energy transfer medium, and it is a renewable energy
3 enabler. Let me explain what I am talking about. First of
4 all, let's talk about hydrogen as energy storage and where
5 it fits in with some of the other technologies. So on this
6 chart, on the X axis, if you will, we are seeing the level
7 of power and, on the Y axis, the amount of time that you can
8 run that particular technology at that particular power, or,
9 in other words, the energy content. So you can see hydrogen
10 is really up at the top. It has the ability to store large
11 amounts of energy with only really pumped hydro and
12 compressed air energy storage being able to do more. So
13 just to show you an example, this graph in the background
14 here shows the wind energy feed-in at the E.ON control area,
15 which is in Germany. And it shows you basically how much
16 power is being fed into the grid via the grid. Now, you can
17 see that if you have a reservoir that is about how much
18 energy storage in the lower left-hand corner that can be
19 stored with that particular technology. And then, likewise,
20 with compressed air technology, it is even less. But if you
21 were to take that same cavern and store hydrogen in it, you
22 are looking at that much amount of energy that can be
23 stored, so really a tremendous amount. So I think this
24 shows how well hydrogen can work. Then, also, a more
25 conventional way of storing hydrogen, you can see the tube

1 trailer, in electrical equivalent it can hold enough
2 hydrogen that is the same as 4 to 6 megawatt hours of
3 electrical energy, that is after the hydrogen is passed
4 through a fuel cell. And you have no leakage, no parasitic
5 losses over time. But what is maybe the most important
6 point on this slide is the cost, the incremental storage
7 cost is less than \$100.00 per kilowatt hour, so it is a
8 fairly cheap way to store hydrogen.

9 Okay, let's get into renewable energy and energy
10 transfer, as well. So the energy storage problem, renewable
11 energy is driving the need for energy storage. We all know
12 that wind and solar are intermittent and, incidentally, when
13 I am talking about renewable energy here, I am more in the
14 mind set of renewable electricity such as wind or solar.
15 Consumers and governments are pushing for more renewable
16 energy to be on the grid, and we know recently Governor
17 Schwarzenegger signed an Executive Order to reach 33 percent
18 by 2020. Other parts of the world, we have seen that
19 problems occur, though, when you put on greater than 10
20 percent of renewable energy onto the grid because of its
21 intermittent nature. And what that means basically, for
22 every kilowatt of wind power you put on, you have to have 1
23 kilowatt of some sort of back-up, like a natural gas peaker,
24 or whatnot. And I will get into this a little bit later,
25 but instead of doing it that way, maybe you can control the

1 load instead of having back-up power, meaning if the wind
2 dies down, maybe you can drop your load off. I am not sure
3 if SMUD has this program, but where I live, Southern
4 California Edison has something they call the Summer
5 Discount Program, and they will pay you a certain amount to
6 take control over your air conditioning unit, so this is
7 something that I subscribe to, and it is similar to what I
8 am going to be talking about in a few slides, but basically
9 over the months of June, July, and August, I get
10 approximately a \$35.00 credit on my electricity bill just to
11 give them the option of taking control of that air
12 conditioner. Incidentally, last year and to date, this
13 year, they have never had to turn off my air conditioning
14 unit. The bottom line here is that higher renewable energy
15 penetration raises the need for energy storage.

16 Now, combine that with the fact that an
17 electrolyzer is what I call "manipulatable," meaning that
18 you can ramp it up, ramp it down, and turn it off. We have
19 done research into our electrolyzers and there really is no
20 problem with turning it on and off, and you can see that the
21 drop is instantaneous as far as turning off that electricity
22 and then turning it back on again. So what this allows, if
23 you are an operator of an electrolyzer, you are obviously
24 consuming electricity to produce hydrogen, but it allows you
25 to enter into what they call a grid ancillary services

1 contract where, again, you give control, or temporary
2 control, of your load to the utility, in exchange for either
3 a lower rate, or for some sort of credit, essentially.

4 And these are different types of grid ancillary
5 services that you can get involved with, and basically they
6 vary from the amount of time that they are on, the amount of
7 time that you have to react to the situation, and so on.
8 The first two are the most important ones, at least for
9 myself, regulation is more like second to minute and
10 spinning reserve is more, you know, minutes to hours type of
11 deal. Incidentally, these do not really occupy a lot of
12 hours in a particular year, so if they are going to turn you
13 off, for example, we are not talking about hundreds of hours
14 per year, we are talking about maybe tens of hours per year.
15 So when people think of hydrogen and energy storage, they
16 typically think of this scenario where, if you have excess
17 power or renewable energy, you would create your hydrogen
18 and then, when you have a deficit, you would then use that
19 hydrogen through a fuel cell to recreate electricity. Okay,
20 we are not talking about that. That is something that we
21 have looked at and, economically, it is difficult to
22 justify. So what we are really talking about here is the
23 opportunity to not immediately, but at a later date, maybe
24 in a decade or so, where you can actually overdrive the
25 grid, if you will, and have an abundance of renewable

1 energy, and then use the electrolyzer to basically correct
2 it so that only the proper amount of electricity is going
3 into the grid. So you can see -- you take the excess
4 energy, put it through the electrolyzer, you store it, and
5 then you dispense it. And this is just a way of showing
6 this with pictures -- you have solar or wind going into
7 hydrogen generation, that electrolyzer, then your are
8 compressing it and storing it, and then eventually
9 dispensing it. Now, putting it into vehicles is not the
10 only way to use the hydrogen; if you can, if you have a
11 customer you can also use this for industrial hydrogen uses,
12 whether it is a hydrogenated oil plant, or whatnot.

13 So the advantages of hydrogen -- long term
14 storage. So you can store this hydrogen essentially for
15 days, weeks, and conceivably months, which is not something
16 you can do with batteries. And there is essentially no
17 leakage, and it is flexible for many uses. Like I said, it
18 could be used for fueling vehicles or for industrial uses,
19 this system is a zero emission throughout, so creating the
20 hydrogen to consuming the hydrogen, as well. And then, of
21 course, the hydrogen technology will continue to develop and
22 efficiency will get better, and so on.

23 So this shows an example basically of what we are
24 talking about in price differences if you get involved with
25 the grid ancillary services contracts while using

1 electrolysis. So in this particular case, we are taking a
2 2,000 kilogram per day unit and then showing that we can get
3 about \$8.25 a kilogram with just business as usual. But if
4 you get involved with a grid ancillary services contract,
5 you are essentially looking at revenue to you of about a
6 million dollars per year, and then resulting in about a
7 reduction of \$1.25 a kilogram, resulting in \$7.00 a
8 kilogram. And this takes into account also the extra
9 storage that you may need to install just to make sure that
10 you have enough hydrogen when they decide to turn down or
11 turn off your unit.

12 So to translate this into vehicles, we just did a
13 simple calculation here using very recent numbers that were
14 published from DOE, Enrol, Savannah River, and Toyota, but
15 basically you have the hybrid gasoline vehicle getting 440
16 miles, approximately 26 miles per gallon, and then the fuel
17 cell hybrid vehicle, it is the same vehicle, 431 miles, so
18 approximately the same range, but in that case 68 miles per
19 gallon, and where I came from today in Santa Clarita, gas
20 was at \$3.15 a gallon, making the total for filling up that
21 tank of \$53.31. If we use \$8.00 a kilogram, for example,
22 then we are looking at \$50.71. So that is basically the
23 breakeven point right now for -- that is where hydrogen
24 needs to be. And basically just showing that we do have a
25 large scale electrolysis that is accessible today, I mean,

1 we are not the only ones, but we do have this available,
2 definitely.

3 So just some closing remarks here, hydrogen -- my
4 main message is that hydrogen is an energy storage and
5 transfer medium, it can be considered a good form of energy
6 storage, particularly when large amount of energy have to be
7 stored, and for long periods of time. Hydrogen can be used
8 as an energy transfer medium and what I mean by that is you
9 can take the energy from the renewable energy sector and
10 transfer it over to the transportation sector, and it can be
11 done at reasonable cost, we believe, with the help of grid
12 ancillary services contracts. And, of course, hydrogen can
13 help smooth out the intermittency of renewable energy
14 sources, which I think is a very important point since we
15 are trying to reach higher levels of grid penetration of
16 renewable energy. So this type of scenario will just feed
17 on itself, enabling further penetration of renewable energy
18 power sources into the grid mix. So the end result is
19 basically lower petroleum consumption, which means increased
20 energy independence and lower cost, less air pollution, and
21 less greenhouse gases. That is my presentation. Thank you
22 for listening. I will be more than happy to take any
23 questions.

24 MS. BAROODY: Thanks, Kevin. Questions?

25 MR. WARD: One question. You mentioned the

1 intermittency problem with renewables. This is just a
2 transmission problem of renewables, too, or can it be done
3 on site of the --

4 MR. HARRIS: Yeah, I mean, it can be done in a
5 variety of ways, either the electrolyzer can be located very
6 close to the renewable energy source, or it can be located
7 downstream. So obviously, if you cut off that power to the
8 electrolyzer, then those electrons that would be flowing
9 would also not be flowing through the transmission lines,
10 and then you would be alleviating those transmission lines.

11 MR. WARD: Thank you.

12 MR. OLSON: And could you also just elaborate on
13 the size -- how big can you go in storage?

14 MR. HARRIS: In storage, well, I mean it really
15 depends on how much real estate you have, the pressure
16 tanks, like that one -- to take an extreme example, but the
17 cavern, this is basically 600,000 Megawatt hours of energy,
18 so if you divide that by 15, approximately, then you are
19 looking at how many kilograms you can actually store of
20 hydrogen.

21 MR. OLSON: But is the medium really the tube
22 trailer idea? Is that --

23 MR. HARRIS: Yeah, that is one way to do it. I
24 think normally, if you were going to set up a project like
25 this, you would not necessarily use a tube trailer, but you

1 would use tanks that are similar to that, that are on the
2 tube trailer, and have it more of a stationary system, so
3 you would not have to pass the DOT regulations, and so on.

4 MR. OLSON: Just to clarify, you get a cost
5 reduction with that process comparing \$8.25 a kilogram to
6 \$7.00?

7 MR. HARRIS: That is right, just by entering into
8 that contract. It does not really cost you anything, you
9 just -- you are a participant in this and you may lose
10 hydrogen production for some period of time, but the fact is
11 that you can buffer yourself, whatever your process is,
12 whether it is refueling buses or cars, or if it is hydrogen
13 used in some process, is that you can buffer that hydrogen
14 in tanks and really not have to suffer anything.

15 MR. OLSON: Have you explored any of the credit
16 system, the renewable energy credits, or the -- the system
17 does not exist for AB 32 yet, but is there a credit for you
18 to do this, say, off-peak, to basically create through the
19 electrolysis, create the hydrogen off-peak when many of the
20 renewable sources are available? And then also bank
21 credits? Have you explored that at all?

22 MR. HARRIS: Not at this point in time, but
23 something we should look into.

24 MR. OLSON: That will be a topic of our next
25 workshop in San Francisco on October 12th is what is the

1 utility role in this, in essence, how do we extract
2 electricity as a source for either electric drive or
3 hydrogen or other sources. And then kind of how do we get
4 to a more comprehensive renewable mix that we can use in
5 transportation, and how do we do that through some of the
6 existing utility tariffs and other programs.

7 MR. HARRIS: Sounds good.

8 MS. BAROODY: Any other questions?

9 MR. MUENCH: One more. Tobias Muench, Commission
10 staff. I am not going to repeat my same old question to you
11 again, but along the lines of that question, your system you
12 are presenting, the electrolyzer, it sounds like something
13 that could present a viable business case to hydrogen
14 fueling and hydrogen as a fuel for transportation. Could
15 you kind of make a few remarks about that in relation to my
16 question? I will be happy to repeat it, if necessary.

17 MR. HARRIS: Well, maybe you should repeat it,
18 just so I could understand it a little bit.

19 MR. MUENCH: Sure. Within the next three to five
20 years, how can we assure that private partners and
21 investment are present to back-out the need for continued
22 public funding, which is becoming increasingly untenable and
23 politically unsustainable?

24 MR. HARRIS: Yeah, I think the answer is similar
25 to the other folks, is we need to get to a certain volume

1 and size because, really, where hydrogen becomes less
2 expensive is using economies of scale, you know, once you
3 get to the 1,000 kilogram per day, and so on. So we need to
4 get to that point, and once we get to that point we can
5 start backing out the government support. One thing I would
6 like to mention, how we can I guess continue to fund some of
7 these programs, we talk about renewable energy credits, and
8 we all understand how that works, you know, you have someone
9 that produces wind power, they get a renewable energy
10 credit, then someone will actually pay for that renewable
11 energy credit. Another way to help fund these programs is
12 selling gasoline, not necessary at a higher tax rate, but
13 attaching what I call domestic energy credit, so we all talk
14 about energy independence and the importance of providing
15 energy domestically, and if you can attach a premium,
16 whether it is two cents a gallon, or whatnot, for gasoline
17 that has a domestic energy credit attached to it, so meaning
18 that the gasoline that I buy, it is going to be made from
19 some sort of, you know, Made in the U.S.A., or Made in North
20 America, or whatever the case may be, I think that would --
21 people would buy that because we are all saying that
22 domestic energy is very important, and then those two cents
23 per gallon can go towards all these programs that we are
24 talking about, that leads to even more domestic energy. So
25 instead of a wreck, we would be talking about a deck.

1 MR. MUENCH: Thank you.

2 MS. BARODY: All right. More questions? Thank
3 you, Kevin, for your presentation. We will head into the
4 public comment period. And I think we have a couple of
5 people. Is it Bob Boyd? From Linde?

6 MR. BOYD: Hi. I just wanted -- we are talking
7 about step changes in terms of installed costs, and I just
8 wanted to touch base on a little bit of what is sort of a
9 relatively unknown group called the HIPOC which is the
10 Hydrogen Industry Panel On Codes, and this was set up a
11 number of years ago by the DOE to help facilitate
12 coordination of Codes and Standards development and changes.
13 With the -- the text has kind of changed -- but to
14 facilitate the successful energy commercial decisions in
15 2015. And originally this was set up with members of what
16 is called the International Codes, or the International Code
17 Council is actually sort of a revitalized fire code,
18 building code, development organization. It used to be
19 Western Codes, and Southern Codes, and a whole bunch of
20 different codes and standards development communities around
21 the country, and it has all kind of been reorganized under
22 the International Code Council. And, for instance, the
23 State of California adopts a series of building codes, fire
24 codes, mechanical codes, electrical codes, and now the 2007
25 California Codes are based on the 2006 ICC Codes, they are

1 not actually what I would call "International," that is
2 just a name, they are really national, the United States.
3 Who is represented at HIPOC is actually a fairly senior
4 bunch of folks there from code enforcement, from the fuel
5 cell industry, representing fuel cell vehicles, we have got
6 the Chair of NFPA 2, the Chair of NFPA 52, it is a very wide
7 group, this is all sponsored by the DOE, there are
8 alternates to each of these representatives, there is
9 someone from Airproducts that is my alternate, there is
10 strong alternates for most of these categories. What is
11 going on today, well, just sort of -- NFK52 is all fuels for
12 transportation, so that has CNG, LNG, liquid hydrogen and
13 compressed hydrogen dispensing technology. The 2010 edition
14 is about to ship from the printer and it has a lot of new
15 provisions for fueling, and NFPA 2 is another code that is
16 going to be all hydrogen and it is absolutely a great code.
17 I mean, most people are pretty bored looking at codes, but
18 the folks have done a great job reorganizing that. And so
19 more work is needed, but the DOE, knocking on wood, is
20 continuing to fund the Code and Development Standard process
21 and we are making some good progress towards our target to
22 see some mature hydrogen codes by 2015. Now, when we say
23 "mature codes," we mean codes that work, that are easy for
24 regulators to interpret, and we believe that this will help
25 make the installation of stations a lot easier. There is a

1 whole bunch of codes and standards, I just picked a few
2 out. They are all sort of in progress of developing. One
3 of the things that we really need is to be able to list
4 devices. There is a group at CSA America that is working
5 feverishly to develop a whole series of codes and standards
6 that aim toward the component level, the components of the
7 hydrogen station, and it is probably worth noting that we do
8 not really have codes and standards that we can list to at
9 this point in time, so that really raised the cost of doing
10 these hydrogen installations over the past five years. So
11 we are making some progress and it will enable us in the
12 2015 to 2020 range to be able to deploy stations at a lot
13 lower cost than we can today, or even in the next five
14 years. Anyway, it is getting better every year. More of
15 this can be seen at the website up there, and all of the
16 meeting Minutes are public, and if there people that want to
17 get involved or submit a proposal, there are ways of doing
18 that. So, Toby, are you going to ask me your question?

19 MR. MUENCH: I do not think that will be
20 necessary. Michael already responded to that. Unless you
21 have anything to add.

22 MR. BOYD: No. Thanks.

23 MR. WARD: Bob, thank you for putting a human face
24 on codes and standards. It made it actually interesting.
25 But I would suggest you call it HIPOC, it just sounds better

1 for some reason.

2 MR. BOYD: HIPOC, yeah, I do not -- yeah, some
3 people call it HIGH POC, and some people call it HIPOC.

4 MR. WARD: HIPOC, that is kind of catchy. But you
5 do think that this will -- and it is imminent, you say, that
6 this is printed, and this could help us for the next
7 stations that we will be developing?

8 MR. BOYD: Yeah, 52 will help a little bit. There
9 is more specific descriptions, particularly around indoor
10 fueling for forklifts, there is a good bit in 52. And I
11 really -- and there is a little bit of nuances to all of
12 this stuff at NFPA, just as an example, NFPA 55 sets the
13 separation distances between the storage tank and any
14 adjacent structures, and things like that. And some of the
15 technical committee at 52 did not like what 55 was doing,
16 and 55 was doing some really advanced research that has been
17 funded by DOE and Sandia in terms of trying to get our
18 separation distance a bit more rational, whereas previously
19 our separation distance were based on, "Well, this fuel is
20 good, so let's just leave it that way." Now we have
21 actually got a scientific reason for why we have setback
22 distances, and those codes in 55 have only changed for
23 compressed, we have not addressed liquid setbacks yet, so we
24 are still using the old setback distances. But the HIPOC
25 group actually made some testimony at the technical

1 committee that had to decide would 52 be allowed to keep
2 the old setback distances, or did 55 have precedence, and so
3 we have actually been successful in focusing on those type -
4 - bringing testimony to people that have to make decisions
5 about this stuff. We have been able to bring some logic, I
6 think, to some of these questions. So NFPA 2 is actually an
7 extractive document that will extract some from -- I am
8 sorry, did I say 52? NFPA 2 is this big huge all hydrogen
9 document, that will extract all the stuff that is relevant
10 from 52 plus all the stuff that is relevant from 55, and put
11 this into an all hydrogen document that is promising to look
12 very very good, and be very helpful. Right now, where that
13 is, is the way NFPA works is they will have a request for
14 proposals, a period of time, people will put in proposals to
15 make changes on the code, in the case of 52, that has
16 already happened. Now, the technical committee and the
17 staff are trying to pull all the approved proposals
18 together, there was a big technical meeting in August, where
19 the good proposals were accepted, and the proposals that did
20 not quite get accepted are still out there as potential
21 proposals for change. And then we now go into what is
22 called the ROC, which is Report on Comments stage, so that
23 the public will have a chance to look at the proposals that
24 did not get accepted during the ROP stage, and then bring
25 added testimony to the technical committee that then may be

1 able to make some further changes in this particular
2 edition of NFPA 2. So it is a long arduous process, and
3 each one of these codes has a different technical committee,
4 and each organization has a different way of working. But
5 we are making some progress across the board.

6 MR. WARD: You mention that DOE is continuing to
7 fund this effort. Were they continuing to fund it even with
8 the budget cut? Was that one of the baseline continuations
9 -- or are they renewing new money?

10 MR. BOYD: Yes, it was, although there was a lack
11 of funding, and there still is a lack of funding. There is
12 a lack of DOE funding that are some contracts that were
13 supposed to be paid, that were not paid, and so there is a
14 reduction in travel right now, some people cannot travel
15 because they are not funded, so there is still a bit of
16 uncertainty with the DOE funding for this, but in principal
17 it was retained.

18 MR. WARD: Is the Congressional restitution of
19 that funding promising for smoothing that out?

20 MR. BOYD: Cautiously, and promising though.

21 MR. WARD: Okay, great. Thanks very much.

22 MS. BAROODY: Thank you, Bob.

23 MR. MUENCH: Bob, could you make any of those
24 codes when they are released finally, can you make those
25 available to us, please? Is that possible?

1 MR. BOYD: Yeah, I can make you aware of them
2 when they are released. You have to purchase them.

3 MR. MUENCH: Yeah, I would be interested.

4 MR. BOYD: I get free copies, but I cannot share
5 it with you.

6 MR. MUENCH: Thanks.

7 MS. BARODY: Thank you, Bob. Asemblon, are you
8 in the house? Okay. Mike -- is it Ramage?

9 MR. RAMAGE: It is Ramage. Well, I have got to
10 tell you, this has been a wonderful day for me. I have
11 really enjoyed this. It is almost like Christmas morning
12 for our technology because everything I have heard, we can
13 enhance or assist all of my colleagues. So without further
14 ado, you will notice we are in Redding, Washington. I am
15 from Washington and I am here to help. And I hope that does
16 not make you cringe to hear that. We have developed over
17 the course of about four years and about \$11 million in
18 private equity funding a simple organic molecule that
19 carries hydrogen. It is liquid over a wide temperature
20 range. It is stored and transported at normal temperature
21 and pressure, so there is no need for cryogenic or pressure
22 treatment. It uses the current -- or will use -- the
23 current fueling infrastructure, so everywhere that there is
24 fueling now for gasoline, we can use that infrastructure for
25 this product. It is as safe as gasoline or diesel, it

1 exceeds the DOE goals, and I will have a graph on that here
2 in just a moment, and it enables renewable energy, which is
3 clearly very important to you for your 2020 goals. And it
4 releases hydrogen, as needed.

5 So to give you a graphic as to how it works, this
6 is very simplistic, the HYDRNOL is run through or in contact
7 with a catalytic surface and a certain amount of hydrogen is
8 released. That molecule with the remaining hydrogen, or the
9 spent HYDRNOL, is then moved to a re-hydrogenation catalytic
10 surface where it is re-hydrogenated with HYDRNOL, and it
11 goes back into service. So we are showing in the lab in
12 excess of 1,000 recycling moments, but we are advertising
13 about 100 in recycling that molecule for commercial use.

14 So the vehicle implementation would be that you
15 hydrogenate the hydrogen, preferably at the source, it does
16 not need to be, but it could be at the source, so let's say
17 you have a methane, or a bovine plant, or a waste landfill,
18 and you hydrogenate there, and then you deliver the HYDRNOL,
19 which is what we call our molecule, it is hydrogenated to
20 the service stations, and I would like to point out that you
21 do not need cryo or compressed vehicles in order to do it,
22 you can use a conventional gasoline tanker, which greatly
23 reduces the cost. A gasoline tanker runs about \$90,000 to
24 \$110,000 a piece, and it is my understanding that the
25 compressed tanker is on the order of \$500,000 to \$600,000,

1 and cryo tankers can be in excess of a million dollars. So
2 we are looking at a very limited CapEx for delivery. So the
3 HYDRNOL station is around a tenth of the cost of a cryo
4 compressed station, and I am just talking about the station,
5 I am not talking about the hydrogenation capability for the
6 moment. So when we talk about 200 stations in the
7 Governor's plan for the hydrogen highway, if you are just
8 talking about the stations at 120 kilograms per day, we can
9 do that for \$40 million. Again, recycling on that molecule
10 is 100 times. This is the DOE target chart that will show
11 you what their ultimate targets are with the 2010 or 2015
12 target. It is a little complicated, but the takeaway
13 message that we have been working with our S47, which is 4.7
14 gravimetric capacity of sulfur molecule for a number of
15 years, just because it is easy to work with in the
16 laboratory. We have now moved to a series of nitrogen
17 molecules, the N67 indicates that it is 6.7 gravimetric
18 capacity, or 6.7 percent weight -- weight by weight.
19 HYDRNOL N108 will be 10.8 percent gravimetric capacity, and
20 we also have an 11.6 that is in development. So we are
21 already well in excess of the DOE targets. And if you look
22 just quickly -- because I have got only five minutes -- if
23 you look quickly at the chemical hydrides and various other
24 types of storage media, we are well at excess of all of
25 those. HYDRNOL, we feel, is a transitional technology. All

1 day today, I have heard about people wanting to transition
2 to renewable energy sources, and make maximum use of the
3 existing infrastructure. Hydrogen can be initially derived
4 from natural gas, initially, and then renewable sources as
5 they become available, so you can bring this online with the
6 technology when it is the appropriate time. You build value
7 from the first installation, so you are not just doing one
8 off for, you know, X number of let's say 45 kilograms a day,
9 you are actually able to expand this technology and the
10 deployment thereof. It does not require significant user
11 re-education. You fill up your tank with a liquid, just
12 like you do with gasoline. Diesel co-combustion can be very
13 quickly implemented at Long Beach, Port of Long Beach, for
14 instance, at a very low cost. We estimate the Class A
15 vehicles can be retrofitted for this purpose for about
16 \$10,000 a piece. There is a low capital cost to deploy,
17 including an existing vehicle retrofit, there are 230
18 million vehicles in the United States right now, that most
19 of them can be retrofitted for a HYDRNOL purpose. And what
20 that means is that the adoption of hydrogen as a usable fuel
21 can be greatly accelerated, and we will be talking in a
22 moment about what that means in terms of revenue generation
23 for the State of California. And the optimal fueling points
24 are already established for gasoline. One of the speakers
25 today talked about selecting a fueling point that is located

1 at the point of greatest use. Well, over the course of
2 decades, the oil and gas companies have located those
3 fueling stations based on population density, so that is
4 already done for us. If we could use those fueling stations
5 and that infrastructure for a liquid that is transparent to
6 the user, just like gasoline, then we can adopt much faster
7 than we have already anticipated.

8 We talked a little bit -- I think Kevin talked
9 about what we call "power shifting." In North Dakota, this
10 is a slide that shows a number of wind farms and the problem
11 is that the production does not match, in fact, the inverse
12 of matching the need. So what you need to do is shift the
13 maximum production of that energy to the point of maximum
14 need. And you can do that by storing that through an
15 electrolyzer process in the HYDRNOL molecule. We have shown
16 that you could store 4.2 Gigawatts of power in HYDRNOL as
17 hydrogen in a 30 foot X 60 foot conventional gasoline tank,
18 which is about a million gallons.

19 This is our hydrogen technical roadmap. You will
20 see that the perfect concept is already done, as an R&D
21 company, we are well out of the R and we are into the D now,
22 we are in the development process, and we have a number of
23 teaming partners that are helping us with that. We are
24 looking for more. The Alpha scale is underway right now
25 with the N67 molecule, we are developing a Beta reactor with

1 Patel Memorial Institute and their Hydrogen Division, it is
2 -- we have a number of teaming partners, there are too many
3 for me to mention in the one minute remaining to me. So I
4 am happy to talk with anyone about our progress in the
5 development path. What I would like to point out is that
6 this really fits very nicely in terms of providing a usable
7 fueling infrastructure to all the OEM light duty vehicles,
8 and all of their plans. They are all looking at 2012 to
9 2015, this fits very nicely.

10 So some of our demonstration partners include
11 Clemson University, International Center for Automotive
12 Research, it does much of the work for BMW and Mazda, we
13 just received a Letter of Endorsement from Mazda on a
14 proposal, an RFI that we submitted to ARPA-E last week with
15 PACCAR and ICAR. For static, we are working with Basin
16 Electric and DOE, there is a wind hydrogen project that we
17 are taking over, actually, in North Dakota here in the next
18 month or so, so we will be demonstrating a footprint for a
19 HYDRNOL station and also a co-combustion. And then small
20 engines, there is significant interest with Enrol, again, at
21 Clemson University and SCIES, South Carolina Institute for
22 Energy Studies. And there are numerous other projects we
23 are working on. Our objective over the course of 18-24
24 months is to demonstrate all of the applications for HYDRNOL
25 which would include onboard, it would include cell tower

1 back-up power, smart grid energy storage, diesel co-
2 combustion, and we are looking for partners to do all of
3 that at this point. We intend to be fully commercialized in
4 the next 24 months. So we see the California opportunity as
5 being this: we can help you to cost-effectively meet the 30
6 percent -- now 33 percent -- by 2030 renewable requirement.
7 We can absolutely reduce diesel emissions, and we can
8 accelerate the hydrogen adoption, and the resulting tax
9 revenues to further supplement renewables. Tobias asked me
10 that question. And then, conversion of legacy internal
11 combustion engine vehicles, versus waiting for a fuel cell
12 vehicle availability. What is important about this is we
13 are not attempting to supplant anyone that is providing
14 energy, or anyone that is going to intend to provide fuel
15 cell vehicles. We want to provide that hydrogen
16 infrastructure and the hydrogen availability to everyone, so
17 that when they get there, it is there, and it is an
18 incentive for them to actually invest in the production of
19 those vehicles. So if there are any questions, I would be
20 happy to answer them.

21 MS. BAROODY: Questions?

22 MR. WARD: I am just wondering if this storage
23 that you say is on the vehicle, it is liquid form like most
24 vehicles have right now, would it be the same range
25 characteristics that you would have with, say, high pressure

1 storage at 5,000 bsi* [4:24] on a vehicle?

2 MR. RAMAGE: That is a great question. There are
3 a number of molecules. The molecule will initially
4 commercialize -- the molecule initially shown in our beta
5 version will be about 20 gallons on board with a 300 mile
6 range; the next molecule will be the 10.8 nitrogen molecule,
7 and that will be about a 15 gallon tank with a 300 mile
8 range.

9 MR. WARD: Do you have auto companies interested
10 in your product at this point?

11 MR. RAMAGE: We do.

12 MR. WARD: Care to tell us anything about that
13 right now?

14 MR. RAMAGE: I would be happy to behind closed
15 doors.

16 MR. WARD: I see. Great, thanks very much.

17 MR. RAMAGE: Thank you.

18 MS. BAROODY: Thanks, Mike, for compressing your
19 presentation into 10 minutes. Are there any more -- do
20 people want to say something during the public comments
21 phase? Pilar, anybody on WebEx?

22 MS. MAGANA: They are all unmuted.

23 MS. BAROODY: Anybody would like to say anything
24 in our online audience? No, okay.

25 MR. WATKINS: This is Larry Watkins.

1 MS. BAROODY: I am sorry, can you say it again?

2 MR. WATKINS: Sorry, this is Larry Watkins. I
3 thought it was a terrific set of presentations.

4 MS. BAROODY: Great, yes.

5 MR. WARD: Thanks, Larry. It has been a very
6 illuminating day, and a long day, and I really want to thank
7 everybody, the folks that are still in the room, and the
8 ones that are still on the phone, well done. And thank you
9 to all the team here at the CEC, as well. It has been very
10 interested, it is very informative, and we will have a lot
11 to digest as we move forward. Thank you.

12 MR. MUENCH: Just one more side note. If anyone
13 on the phone or on the WebEx, or here in the room has any
14 important documents they believe we should see, please
15 submit them through the docket process, it is on the
16 website, to make sure that we look at these things outside
17 of what was presented here today. Thank you very much. I
18 think this has been a great first day of various new points.
19 I appreciate all participation. Thank you.

20 MS. BAROODY: And those comments are due to the
21 docket by October 6th. Also, the audio and transcripts and
22 presentations will be on our website hopefully within the
23 next week. I think that should do it. Thank you so much,
24 again, for all your presentations and for being here today.

25 (Whereupon, at 4:55 p.m., the workshop was adjourned.)

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CERTIFICATE OF REPORTER

I, PETER PETTY, an Electronic Reporter, do hereby
certify that I am a disinterested person herein; that I
recorded the foregoing California Energy Commission
Workshop; that it was thereafter transcribed into
typewriting.

I further certify that I am not of counsel or
attorney for any of the parties to said meeting, nor in any
way interested in outcome of said meeting.

IN WITNESS WHEREOF, I have hereunto set my hand
this _____ day of October, 2009.

PETER PETTY